UNIVERSITY OF FORWARD THINKING WESTMINSTER

Programme Specification

Course record information

Name and level of final award:	MSc Electronics with Robotic and Control Systems MSc Electronics with Embedded Systems MSc Electronics with System-on-Chip Technologies MSc Electronics with Medical Instrumentation
Name and level of intermediate awards:	Postgraduate Diploma (PGDip) Electronics Postgraduate Certificate (PGCert) Electronics
Awarding body/institution:	University of Westminster
Status of awarding body/institution:	Recognised Body
Location of delivery:	Cavendish
Language of delivery and assessment:	English
Course/programme leader:	
Course URL:	
Mode and length of study:	Full-Time; Part-Time (Two-year); Part-Time (Three-year)
University of Westminster course code:	
JACS code:	H610
UCAS code:	
QAA subject benchmarking group:	Electronic Engineering Computer Science
Professional body accreditation:	IET
Date of course validation/review:	2015
Date of programme specification:	2015

Admissions requirements

MSc Electronics with Robotics and Control Systems:

Qualifications equivalent to a good Honours degree (i.e. minimum a good 2:2) from a British university in electronic engineering or a good Honours degree in computer science, mathematics or other technological subject with a knowledge of mathematics, programming and digital systems. Relevant work experience will be taken into account. An IELTS score of 6.5 or equivalent will normally be required from applicants whose first language is not English, or who have not studied their secondary and bachelor's degree education in English.

MSc Electronics with Embedded Systems:

Qualifications equivalent to a good Honours degree (i.e. minimum a good 2:2) from a British university in electronic engineering or a good Honours degree in computer systems engineering, computer science, mathematics or other technological subject with a knowledge of programing, mathematics and/or digital systems. Relevant work experience will be taken into account. An IELTS score of 6.5 or equivalent will normally be required from applicants whose first language is not English, or who have not studied their secondary and bachelor's degree education in English.

MSc Electronics with System-on-Chip Technologies:

Qualifications equivalent to a good Honours degree (i.e. minimum a good 2:2) from a British university in electronic engineering or a good Honours degree in computer science, mathematics or other technological subject with a knowledge of mathematics and digital systems. Relevant work experience will be taken into account. An IELTS score of 6.5 or equivalent will normally be required from applicants whose first language is not English, or who have not studied their secondary and bachelor's degree education in English.

MSc Electronics with Medical Instrumentation:

Qualifications equivalent to a good Honours degree (i.e. minimum a good 2:2) from a British university in electronic engineering or a good Honours degree in computer science, mathematics or other technological subject with a knowledge of mathematics and digital systems. Relevant work experience will be taken into account. An IELTS score of 6.5 or equivalent will normally be required from applicants whose first language is not English, or who have not studied their secondary and bachelor's degree education in English.

Aims of the courses

The overall aim of the electronic suite of MSc courses is to provide an enriching learning experience, enhancing the knowledge and skill base of the participating students in the area of modern electronic systems design. In particular the courses will develop advanced practical skills to enable the student to determine system requirements, select and deploy a suitable design process and use the latest specialist tool chains to test and/or prototype a device or algorithm. Modern electronic systems today are a combination of software and hardware solutions that require engineers with cross discipline skills to implement them. The courses in the electronic suit cover a broad range of disciplines that will enable a successful graduate to enter into a career that requires a cross disciplined approach and a practical hardware and software skillset. The courses are intended both for engineers in current practice and for fresh honours graduates to facilitate their professional development, mobility and employability.

More specifically, the generic aims of the courses are to:

G1. Encourage a lively investigative spirit that will sustain a commitment to independent future study.
G2. Provide communication skills associated with oral and written presentations of technical work and develop interpersonal and organisational skills associated with project planning, execution and appraisal.
G3. Provide individualised experience of a significant individual project which exploits and applies disparate modules of knowledge.
G4. Foster a spirit of independent student-centred study with effective management of time and development of research methods.
G5. Provide a broad coverage of engineering topics that includes not only technical design issues but also a wider set of considerations including social and economic issues, ethical issues and environmental issues.
G6. Develop team work skills by providing a frame work of team activities

MSc Electronics with Robotic and Control Systems

In addition, the MSc in Electronics with Robotic and Control Systems aims to produce postgraduates with a strong practical skill base that will enable them to model, analyse, design and prototype smart robotic sub-systems. Specialist knowledge and practical skillsets will be taught, extensively developed and practiced in the areas of control systems and the analysis, categorisation and design of robotic systems that facilitate movement with multiple degrees of freedom.

The knowledge and skillsets taught within the course are extensively used in the design of smart robotic devices used in industry such as assembly line robots. They are also the key enabling skillsets used to implement devices for applications such as security drones, warehouse robots, medical robots and more humanoid like robots. In addition smart instrumentation will be explored such as machine vision systems both in terms of the algorithms used and the interfaces and hardware required.

Broader considerations such as the social and economic impact of robot devices, ethical and roboethics issues, health and safety and existing and forthcoming legislative issues will be examined. It is intended that the course will re-focus and enhance existing knowledge in the areas of software engineering, electronic engineering and real-time embedded systems to enable the student to participate in the fast expanding and exciting sector of industrial and consumer robotic systems.

In particular, the course aims to:

ERC1. teach advanced system level design, documentation and implementation approaches and provide practical experience in the development and prototyping of electronic systems in the context of robotics using innovative product design methodologies, platforms and tools.

ERC2. explore broader issues concerning the adoption and processes of robotic systems and their cognitive systems including legislation for robotic devices, safety considerations and product life cycle

ERC3. teach the theoretical background and develop practical skills to analyse, design and test practical control systems for use in the field of robotic systems

ERC4. develop skills in the deployment and programming of real-time control systems and smart instrumentation in robotic systems by providing first-hand experience in prototyping a robotic system.

ERC5. teach and deploy mathematical and software based tools to analyse, model and describe the motion and behaviour of robotic devices with limbs that allow multiple degrees of freedom.

ERC6. deploy software tools to design and test algorithms for smart instrumentation and show how smart image sensor systems can be developed using standard image processing techniques, media interfaces and devices to enable a robot to undertake decision making tasks on complex data.

MSc Electronics with Embedded Systems

In addition, the MSc in Electronics with Embedded Systems aims to produce postgraduates with an advanced level of understanding in the design of real-time embedded systems for time-critical, power sensitive applications. In particular the course will provide in-depth critical understanding of the underlying principles as well as the use and deployment of requirements analysis techniques, design methodologies, design process methodologies, embedded systems programming, common 32-bit and 8-bit Micro-Controller-Unit (MCU) architectures, smart instrumentation devices and the latest development tool chains.

Practical skillset development is emphasized throughout the course; the student will design, build and test embedded systems, these activities will be supported by our laboratory environment. Students will be taught the theory, protocol and the efficient use of both analogue and digital interfaces and sensor devices. Complex time-critical system requirements will be met by teaching the principles of and using a Real-Time-Operating-System (RTOS). In addition the course will provide an in-depth discussion of the underlying power management hardware sub-systems within modern MCUs and will show and use software techniques that will exploit these to reduce power consumption.

Broader consideration of embedded system design will be explored by investigating how system cost, choice of design process, implementation and performance are informed or controlled by factors such as risk, operating environment, product life-cycle, software life-cycle, safety and regulation. It is intended that the course will re-focus existing knowledge held by the student in software engineering and hardware engineering and deliver a set of enhanced practical skills that will enable the student to fully participate in this multi-disciplined, fast expanding and dominating engineering sector of embedded systems.

In particular, the course aims to:

EES1. teach advanced system level design, documentation and implementation approaches and provide practical experience in the development and prototyping of embedded systems using innovative product design methodologies, platforms and tools.

EES2. explore broader issues concerning the design and application of embedded systems including risk analysis, costs, operating environment, product and software life-cycle, regulation, quality insurance processes and design process choices for mission and safety critical embedded systems.

EES3. provide a first-hand experience in the requirements analysis, design, build and test, together with the use of the latest development tools, by getting the student to prototype a stand-alone micro-controller application.

EES4. develop know-how in the use, critical evaluation and deployment of the latest development systems, software solutions, sensors, interface protocol, instrumentation, modern Micro-Controller-Unit (MCU) architectures and other external hardware sub-systems to realise a reliable ,efficient and timely solutions.

EES5. explain and deploy advanced software techniques to exploit the underlying power management architecture found in modern MCUs to realise low power solutions.

EES6. teach supporting theory, apply scheduling algorithms and use existing and emerging Real-Time-Operating Systems (RTOS) to satisfy complex real-time system requirements.

MSc Electronics with System-on-Chip Technologies

In addition, the MSc Electronics with System-On-Chip Technologies aims to produce postgraduates with an advanced understanding of the various routes to implementing systems-on-chip (SoC) and with hands-on experience of the design of such systems using several approaches to their implementation.

In particular, the course aims to:

ESC1. teach advanced system level design, documentation and implementation approaches and provide practical experience in the development of system-on-chip solutions using popular design methodologies and tools chains used in industry.

ESC2. explore broader issues concerning the design and implementation of system-on-chip solutions and their final application areas including quality insurance, ethics, risk analysis, regulation, legislation, intellectual property rights and life-cycle.

ESC3. produce students who are “silicon qualified” by providing them with a complete SoC design experience by setting a framework of activities that allow the student to use industry-standard Computer-Aided-Engineering

(CAE) software tools for the fast and accurate design, simulation and verification of integrated circuits.

ESC4. establish proficiency in custom integrated circuit design at various levels of system hierarchy including realisation of algorithmic specifications, behavioural modelling, logic synthesis, digital design, transistor-level design and layout-level design.

ESC5. promote an awareness of, and competence in dealing with, the issues specific to VLSI system design; in particular, issues of testability and complexity management.

ESC6. Introduce an armoury of possible architectural solutions to particular system requirements especially in applications requiring very high computational efficiency such as DSP.

MSc Electronics with Medical Instrumentation

In addition, the MSc in Electronics with Medical Instrumentation aims to produce postgraduates with an understanding of medical instrumentation based systems used for monitoring; detecting and analysing biomedical systems as well as professional engineering skills required to design and implement such systems.

The course will develop practical skill sets and an in-depth understanding of state-of-the-art tools and algorithms that can be used to implement and test diagnostic devices, therapeutic devices, medical imaging equipment and medical instrumentation devices. In particular the course will explore the use of Matlab and Simulink to develop and test medical signal and image processing algorithms with an aim to prototype low-cost diagnostic equipment. This will be placed into context by further discussing the functionality, underlying principles, accessibility and limitations of a range of existing medical equipment and future trends. The course will also provide an overview of medical transducers and biosensors and provide a framework of hands-on activities to deepen the practical skillset of the student by allowing the student to understand and explore their use.

The course broadens the discussion of medical equipment and its design by investigating a range of issues including medical equipment regulation, user requirements, impacts of risk, regulatory practice, legislation, quality insurance mechanisms, certification, ethics and ‘health and safety’ assessment. These issues are then put into context by assessing how they impact the design process, the overall design of the system and costs.

The course will enable a student with an interest in medical electronics to re-focus existing knowledge gained in software engineering, embedded systems engineering and/or electronic systems engineering and will deliver a set specialist practical skills and a deeper understanding of the underlying principles of medical physics. A graduate from this course will be able to immediately participate in this multi-disciplined engineering sector of biomedical and medical instrumentation systems design.

In particular, the course aims to:

EMI1. teach advanced system level design, documentation and implementation approaches and provide practical experience in the development and prototyping of medical diagnostic equipment, medical instrumentation and therapeutic equipment using innovative solutions, platforms and tools.

EMI2. explore broader issues concerning the design and application of medical equipment including risk analysis, costs, operating environment, user requirements, product and software life-cycle, regulation, quality insurance processes and design process choices for safety critical medical electronic systems.

EMI3. provide first-hand experience in requirements identification, specification, design, build and test of a low-cost medical device.

EMI4. develop in-depth understanding of medical physics and human anatomy then use this to help understand and explore the operation of existing medical image techniques and the design and implementation of medical equipment.

EMI5. teach state of the art algorithms in the area of medical signal processing and image processing that can be applied to medical instrumentation, therapeutic equipment and diagnosis equipment.

EMI6. explore and assess the fundamental principles, architectures, interface requirements, functionality and characteristics of existing bio-medical equipment and bio-medical instrumentation, bio-sensors, transducers and electrodes and identify their limitations and application areas through theory and experimentation.

Employment and further study opportunities

Today's organisations need graduates with both good degrees and skills relevant to the workplace, i.e. employability skills. The University of Westminster is committed to developing employable graduates by ensuring that:

- Career development skills are embedded in all courses
- Opportunities for part-time work, placements and work-related learning activities are widely available to students
- Staff continue to widen and strengthen the University's links with employers in all sectors, involving them in curriculum design and encouraging their participation in other aspects of the University's career education and guidance provision
- Staff are provided with up-to-date data on labour market trends and employers' requirements, which will inform the service delivered to students.

The subject areas covered within the four pathways in the electronic suite of MSc courses offer students an excellent launch pad which will enable the successful graduate to enter into these ever expanding, fast growing and dominant areas within the electronic engineering sector. With ever increasing demands from consumers such as portability, increased battery life and greater functionality combined with reductions in cost and shrinking scales of technologies modern electronic systems are finding ever more application areas. This has led to an explosion in embedded system devices, a requirement to have system on-chip solutions to reduce the size and power consumption of devices and an increase in their market share as medical devices and robotic devices enter the main stream consumer market.

Industry and users have fed the explosion in demand for advancements in medical electronics. In particular demands for complex user interfaces, demands to reduce equipment costs, demands for greater accessibility of equipment and the demand for greater portability of equipment has become common place. This has led to expanding opportunities within the modern electronic engineering sector. In particular there is a need for engineers that can solve problems requiring a multi-disciplined approach covering skills from software engineering, control engineering, digital electronic systems engineering, analogue electronic engineering, medical physics, and mechanics amongst others.

The MSc degrees offered will provide the foundations required to re-focus existing knowledge and enter the world of multi-disciplined jobs. Possible job titles that a successful graduate with the relevant background education and experience may inspire to include:

- Electronic systems design engineer
- Robotic systems design engineer
- Embedded systems design engineer
- System-on-chip embedded systems engineer
- Measurements and instrumentation engineer
- Medical electronic design engineer
- Control systems engineer
- Plant control engineer
- Computer systems engineer
- Software engineer

In various industries such as:

- Electronic systems industry
- Medical equipment manufacturers
- Assembly line manufacturers
- Robotics and home help industries
- Logistics and distribution industries
- Instrumentation industry
- Transport industries
- Automobile industry
- Aviation industry
- Consumer industry
- Life-style industry
- Toy industry
- Security and surveillance industry
- Petro-chemical industry

The lists above are not prescriptive or exhaustive. There are many companies that require engineers that have good software and hardware skills combined with a high level of knowledge in robotic systems and medical technologies. This has increased tremendously over the past few years as digital electronic systems and system-on-chip solutions have led to a convergence within these subject areas. Despite the high demand for engineers that are competent in hardware and software disciplines, currently the supply of good systems engineers, that can fulfil all the requirements of these sectors, is too small. This has led to increased demand as companies scramble to get the best candidates that they can.

Learning outcomes

General Learning Outcomes

Knowledge and understanding

Graduates will satisfy the following criteria:

G1: they will be able to demonstrate their knowledge and understanding of essential facts, concepts, theories and principles pertaining to their area of engineering, and its underpinning science and mathematics. They will appreciate the social, environmental, ethical, economic and commercial considerations affecting the exercise of their engineering judgement.

Specific skills

G2: they will be able to apply appropriate quantitative science and engineering tools to the analysis of problems. They will be able to demonstrate creative and innovative ability in the synthesis of solutions and in formulating designs. They will be able to comprehend the broad picture and thus work with an appropriate level of detail.

G3: they will possess practical engineering skills acquired through, for example, work carried out in laboratories; in project work; in design work; and in the use of computer software in design and analysis.

Key transferable skills

G4: they will have developed transferable skills that will be of value in a wide range of situations. These skills include:

- The ability to exercise initiative and personal responsibility whilst working with others.
- The ability to plan self-learning and improve performance, as the foundation for lifelong learning
- The ability to communicate effectively through written reports and presentations and the ability to handle competently technical questioning.
- The ability to use effectively general IT and information retrieval facilities.
- The ability to develop, monitor and update a plan, to reflect a changing operating environment.
- The ability to monitor and adjust a personal programme of work on an on-going basis, and to learn independently;
- The ability to learn new theories, concepts, methods, etc and apply these to solve problems in unfamiliar situations.

Specific Learning Outcomes

1. Science and Mathematics

MSc Electronics with Robotic and Control Systems

Graduates will be able to demonstrate:

SM1fl a comprehensive understanding of the mathematical tools used to model the behaviour of dynamic systems, kinematic systems and the underlying control systems that are used to realise the implementation of robotic systems;

SM2fl an awareness of the limitations of current practices, technologies and state-of-the-art techniques used in robotic systems and their sub-systems and how these limitations affect the adoption of robotic systems in various application areas;

SM3fl know-how in the analysis, modelling, deployment and underlying principles of cognitive systems, mechanical systems and image systems used in robotic systems together with a broader understanding of legislation, safety, ethical and sociological issues and how these limit or influence the adoption and/or design of robotic systems in both individual coursework's and a final complex engineering project.

MSc Electronics with Embedded Systems

Graduates will be able to demonstrate:

SM1fl a comprehensive understanding of the mathematical tools, mathematical principles and scientific principles required to solve a given problem including the following: power consumption within an embedded system, common bus interfaces, actuators, signal acquisition systems, sensory devices and static and dynamic scheduling algorithms for soft and hard real-time systems;

SM2fl an awareness of the limitations of the; latest Micro-Controller Unit (MCU) architectures including functionality, capacity, peripheral sets and power management systems; development systems, sensor devices, data converters and actuators, wired and wireless interfaces; Real-Time Operating Systems (RTOS) and scheduling algorithms together with insight into the latest trends in embedded system tool development and technologies;

SM3fl the ability to critical evaluate the suitability and then effectively deploy a given design process, development system, programming style and language, Micro-Controller-Unit (MCU) architecture, communication standard and/or sub-system, task scheduling algorithm or external sub-system to ensure that the timing, functional requirements, ethical concerns, legislative requirements, regulatory processes and certification requirements of a given embedded system can be met, in both individual practical coursework's and a final complex engineering project.

MSc Electronics with System-on-Chip Technologies

Graduates will be able to demonstrate:

SM1l a comprehensive understanding of the scientific principles and underlying mathematics of microelectronic systems and related disciplines including; the relationship between technology scaling , clock speed and power dissipation; principles of PMOS, NMOS and CMOS technologies and the underlying implementation of logic gates; logic analysis and synthesis; signal processing systems and communication systems;

SM2fl an awareness of the limitations of existing technologies and tool chains together with an awareness of the advantages of ever smaller scales of integration and advancements in development tool chains, testing strategies and design methodologies related to microelectronics and SoC design methodologies;

SM3fl an understanding of concepts from a range of application areas for System-on-Chip solutions, and the ability to apply them effectively in engineering projects.

MSc Electronics with Medical Instrumentation

Graduates will be able to demonstrate:

SM1fl a comprehensive understanding of the underlying; science of biomedical equipment, therapeutic equipment and biosensors; mathematical principles of image and signal processing; physical principles and dynamics of biomedical instrumentation;

SM2fl a critical awareness of the functionality, accessibility and cost of existing systems and insights of how new low-power highly integrated System-On-Chip solutions, fast prototyping embedded system solutions and tool chains, increased performance of array based image sensors and the latest low-cost consumer technologies can be used to increase accessibility, reduce user interface complexity, reduce cost and size to enable a wider range of people to benefit;

SM3fl understanding of the underlying principles and concepts of medical instrumentation through critical evaluation of existing biomedical equipment in terms of physical principles, sensor dynamics and electronic circuitry used; the ability to apply the functionality of various biosensors, transducers and electrodes in the implementation of a device that will measure physiological variables, in both individual coursework’s and a final complex engineering project.

2. Engineering Analysis

MSc Electronics with Robotic and Control Systems

Graduates will be able to demonstrate:

EA1fl in-depth know-how in the analysis and modelling of various complex sub-systems of robotic systems to facilitate optimal performance, robustness of control and stability together with an understanding of the limits of the models and analysis tools used;

EA2fl the ability to evaluate and review the research and/or industry issues in the area of robotic systems and control within a project domain given fundamental knowledge of the analysis and design tools used for robotic systems and where appropriate investigate and appraise new emerging technologies;

EA3fl the ability to use effectively appropriate methods of gathering and analysing information including research data to formulate a proposal that presents and/ or defends research and current practice in the area of robotic and control systems and then apply the appropriate innovative techniques, adaptation of an existing engineering analytic method or use of appropriate analysis techniques and tools to solve a complex real problem.

MSc Electronics with Embedded Systems

Graduates will be able to demonstrate:

EA1fl the ability to perform requirements analysis of complex embedded systems to identify overall timing requirements and functional requirements; the ability to use analytic tools to analyse the functionality and timing of various hardware sub-systems, software processes and scheduling systems deployed to ensure that the real-time constraints and overall functional requirements identified can be met; the ability to inform the design process based on the analysis undertaken with an understanding of the limitations and practical implications of the analytical tools used;

EA2fl the ability to evaluate and review the research and/or industry issues in the area of embedded systems design methodology within a project domain given fundamental knowledge and where appropriate investigate and appraise new emerging technologies and methodologies;

EA3fl the ability to use effectively appropriate methods of gathering and analysing information including research data to formulate a proposal that presents and/ or defends research and current practice in the area of embedded systems development and then apply the appropriate innovative techniques, adaptation of an existing engineering methodology or use of appropriate design processes and tools to solve a complex real problem.

MSc Electronics with System-on-Chip Technologies

Graduates will be able to demonstrate:

EA1fl the ability to breakdown a task into fundamental building blocks, identify the core timing and functional requirements of these blocks, and deploy state-of-the-art analysis tools to simulate functionality and timing, estimate silicon area and estimate power dissipation, then inform the design process based on an interpretation of these results given the understanding of the limitations of such tools for a complex system-on-chip solution;

EA2fl the ability to evaluate and review the research and/or industry issues in the area of System-on-Chip (SoC) technologies and tool chains within a project domain given fundamental knowledge and where appropriate investigate and appraise new emerging technologies and methodologies;

EA3fl the ability to use effectively appropriate methods of gathering and analysing information including research data to formulate a proposal that presents and/ or defends research and current practice in the area of System-on-Chip (SoC) design and then apply the appropriate innovative techniques, adaptation of an existing design methodology or use of the appropriate design processes and tools to solve a complex real problem.

MSc Electronics with Medical Instrumentation

Graduates will be able to demonstrate:

EA1fl the ability to apply analysis techniques and tools to evaluate and apply the functionality of various analogue and digital circuits, biosensors, transducers, electrodes and optical/ medical signal processing techniques for the measurement of physiological variables and the ability to use these results to inform the design and implementation of diagnostic and therapeutic equipment;

EA2fl the ability to evaluate and review the research and/or industry issues in the area of medical instrumentation within a project domain given fundamental knowledge and where appropriate investigate and appraise new emerging technologies and methodologies;

EA3fl the ability to use effectively appropriate methods of gathering and analysing information including research data to formulate a proposal that presents and/ or defends research and current practice in the area of medical instrumentation and then apply the appropriate innovative techniques, adaptation of an existing design or use of the appropriate design processes and tools to solve a complex real problem.

3. Design

MSc Electronics with Robotic and Control Systems

Graduates will be able to demonstrate:

D1fl the ability of using knowledge gained to determine the initial requirements of a given robotics and/or control problem with an incomplete or uncertain description by analysing, modelling and solving the dynamic and kinematic behaviour and/or path trajectories of a robotic system; the ability to determine an initial specification for the solution based on the requirements identified; the ability to implement a prototype test bench by writing real-time software for the solution on a given development platform and through experimentation quantify the effects of various configuration and parameter choices in respect of functionality, performance, robustness and stability to produce the final design and solution;

D2fl the ability to undertake a complex project in the area of robotic and control systems that is unfamiliar; the ability to select a suitable design process and methodology and apply them; the ability to communicate the objective defence of the chosen design process against other possible selections taking into account the nature of the technical solution and a broader range of engineering issues including professional codes of practice, commercial risk, sustainability, social impact, legislation, regulatory practice, robo-ethics and risk analysis;

D3fl the ability to independently work on and solve complex real problems in the robotic and control systems area from specification to final build and test, by applying, modifying where appropriate, and deploying advanced engineering techniques and tools to solve new design problems; the ability to critically evaluate their own work knowing current solutions and practices, identifying limitations of their work and assessing contributions of their work with respect to the existing knowledge base.

MSc Electronics with Embedded Systems

Graduates will be able to demonstrate:

D1fl the ability of using theoretical knowledge and practical understanding gained of the timing requirements and behaviour of real world interfaces, signal acquisition sub-systems, inter-processor communication systems, external hardware subsystems, Micro-Controller-Unit (MCU) architectures, peripheral resources, documentation tools, real-time software tools and scheduling algorithms to determine and document the initial requirements and specification of a complex embedded system problem with an incomplete or uncertain description; the ability to build a prototype device based on the initial requirements and specification identified and use analytic and quantative experimental methods informed by the understanding of the system under test to establish a final solution that meets all system requirements through an iterative design, build, code and test approach;

D2fl the ability to undertake a complex project in the area of embedded systems that is unfamiliar; the ability to select a suitable design process and methodology and apply them; the ability to communicate the objective defence of the chosen design process against other possible selections taking into account the nature of the technical solution and a broader range of engineering issues including professional codes of practice, commercial risk, sustainability, social impact, legislation, regulatory practice, ethical issues and risk analysis;

D3fl the ability to independently work on and solve complex real problems in the embedded systems development area from specification to final build and test, by applying, modifying where appropriate, and deploying advanced engineering techniques and tools to solve new design problems; the ability to critically evaluate their own work knowing current solutions and practices, identifying limitations of their work and assessing contributions of their work with respect to the existing knowledge base.

MSc Electronics with System-on-Chip Technologies

Graduates will be able to demonstrate:

D1fl the ability of using theoretical knowledge and practical understanding of signal processing algorithms, intellectual property (IP) blocks, System-on-Chip Technologies and state-of-the-art software tool chains to design, enter, synthesise and test a complex System-on-Chip (SoC) solution for a problem that is not fully specified or uncertain; the ability to identify functional sub-blocks and then use their understanding of logic design, the target device and High-Level-Design language (HDL) tools to describe these sub-blocks and write a set of test bench files to test and verify the operation of these sub-blocks through logical and back annotated timing simulations for a given target device or silicon process; the ability to construct and apply an iterative experimental design process until all timing requirements and functional requirements are met as confirmed by the test bench files;

D2fl the ability to undertake a complex project in the area of System-on-Chip (SoC) design that is unfamiliar; the ability to determine system and/or algorithmic requirements and select a suitable design process and methodology and apply them; the ability to communicate the objective defence of the chosen design process and methodology against other possible selections taking into account the nature of the technical solution and a broader range of engineering issues including professional codes of practice, commercial risk, sustainability, social impact, legislation, regulatory practice, ethical issues and risk analysis;

D3fl the ability to independently work on and solve complex real problems using System-On-Chip (SoC) technologies from specification to final build and test, by applying, modifying where appropriate, and deploying advanced engineering techniques and tools to solve new design problems; the ability to critically evaluate their own work knowing current solutions and practices, identifying limitations of their work and assessing contributions of their work with respect to the existing knowledge base.

MSc Electronics with Medical Instrumentation

Graduates will be able to demonstrate:

D1fl the ability to critically evaluate and use theoretical understanding of bio-engineering methodologies to monitor and diagnose biological signals irregularities; understanding of underlying scientific principles and the functionality of various biosensors, transducers and electrodes to help identify the requirements and specification of a complex problem in the area of medical instrumentation who's solution is not fully described and/or uncertain; the ability of the student to quantify the uncertainty of the specification and behaviour of the hardware sub-systems used in the build of a prototype medical device and identify how this uncertainty may change the overall functionality of the device; the ability of a student to construct a suitable test bench and apply knowledge gained to devise an experimental iterative design approach to produce a final solution that meets the required specification;

D2fl the ability to undertake a complex project in the area of medical instrumentation that is unfamiliar; the ability to select a suitable design process and methodology and apply them; the ability to communicate the objective defence of the chosen design process against other possible selections taking into account the nature of the technical solution and a broader range of engineering issues including professional codes of practice, commercial risk, sustainability, social impact, legislation, regulatory practice, ethical issues and risk analysis;

D3fl the ability to independently work on and solve complex real problems in the area of medical instrumentation from specification to final build and test, by applying, modifying where appropriate, and deploying advanced engineering techniques and tools to solve new design problems; the ability to critically evaluate their own work knowing current solutions and practices, identifying limitations of their work and assessing contributions of their work with respect to the existing knowledge base.

4. Economic, Legal, Social, Ethical and Environmental Context

MSc Electronics with Robotic and Control Systems

Graduates will be able to demonstrate:

ET1fl the ability to fully articulate the importance of high levels of professional and ethical conduct given knowledge and understanding of development costs and the sociological impacts caused by the use and cognitive reasoning power of modern robotic devices; the ability of the student to write technical reports to prescribed standards and formats, to work to deadlines and to critically evaluate their work and give a critical reflection of the planning and management of their professional development;

ET2fl the ability to communicate an objective defence of the chosen design process taking into account commercial risk, codes of practice, ethical requirements, safety requirements and the social impact of robotic and control systems ;

ET3fl the ability to communicate an objective defence of the chosen business arguments taking into account commercial risk, codes of practice, ethical requirements, safety requirements and the social impact of robotic and control systems ;

ET4fl the ability to identify required resources and defend and deploy methodologies, business arguments and design processes that will ensure sustainable development;

ET5fl the ability to communicate an objective defence of the design process, design methodology and/or business arguments chosen given the regulatory requirements in the area of robotic and control systems;

ET6fl the ability of the student to evaluate risks related to the environment, safety of robotic and control devices and where appropriate commercial risk.

MSc Electronics with Embedded Systems

Graduates will be able to demonstrate:

ET1fl an awareness of the need for a high level of professional and ethical conduct by carefully analysing a complex real embedded system problem, then selecting and deploying a suitable design process, then informing the design process by identifying ethical issues related to the underlying application and product life-cycle requirements; the ability of the student to write technical reports to prescribed standards and formats, to work to deadlines and to critically evaluate their work and give a critical reflection of the planning and management of their professional development;

ET2fl the ability to communicate an objective defence of the chosen design process taking into account commercial risk, codes of practice, ethical requirements, safety requirements and the social impact of the underlying application area of a given safety critical embedded system solution;

ET3fl the ability to communicate an objective defence of the chosen business arguments and design process given knowledge of various design process methodologies, business models, quality assurance systems, regulatory practices and certification requirements for a complex safety critical embedded system application;

ET4fl the ability to identify required resources and defend and deploy methodologies, business arguments and design processes that will ensure sustainable development;

ET5fl an awareness of the regulatory requirements in the application area for a given embedded system solution and how these will impact on the design process and design methodology;

ET6fl the awareness and ability to evaluate risks related to the environment, health and safety and where appropriate commercial risk for a given embedded systems application area.

MSc Electronics with System-on-Chip Technologies

Graduates will be able to demonstrate:

ET1fl the ability to show an awareness and clearly indicate the importance of high levels of professional and ethical conduct by initiating processes and identifying system requirements that are fully informed by ethical issues in the application area of a given System-On-Chip (SoC) solution; the ability of the student to write technical reports to prescribed standards and formats, to work to deadlines and to critically evaluate their work and give a critical reflection of the planning and management of their professional development;

ET2fl the ability to communicate an objective defence of the chosen design process and/or design methodology taking into codes of practice, commercial risk and the social impact of the underlying application area for a given System-On-Chip (SoC) solution;

ET3fl the ability to communicate an objective defence of the chosen design process given knowledge of various design process methodologies, business models, quality assurance systems, regulatory practices and certification requirements for the underlying application area for a given System-On-Chip (SoC) solution;

ET4fl the ability to defend and deploy methodologies, business arguments and design processes that will ensure sustainable development for the entire system including the System-On-Chip (SoC) solution;

ET5fl an awareness of the regulatory requirements in the application area for a given System-On-Chip (SoC) solution and how these will impact on the selection of a given design process and design methodology;

ET6fl an awareness and ability to evaluate risks related to the environment, health and safety and where appropriate commercial risk for the underlying application area for a given System-On-Chip (SoC) solution.

MSc Electronics with Medical Instrumentation

Graduates will be able to demonstrate:

ET1fl the ability to show an awareness and clearly indicate the importance of the high levels of professional and ethical conduct required in the area of medical instrumentation by initiating processes and identifying system requirements that are fully informed by general and medical ethics; the ability of the student to write technical reports to prescribed standards and formats, to work to deadlines and to critically evaluate their work and give a critical reflection of the planning and management of their professional development;

ET2fl the ability to communicate an objective defence of the chosen design process and/or design methodology for the design of a given medical instrument taking into codes of practice, commercial risk and impacts on society including the accessibility and importance of the diagnosis and/or treatment solution;

ET3fl the ability to communicate an objective defence of the chosen design process, business model and/or business arguments given knowledge of various design process methodologies, business models, quality assurance systems, regulatory practices, legislation and certification requirements associated with the design of a given medical instrumentation device;

ET4fl the ability to defend and deploy methodologies, business arguments and design processes that will ensure sustainable development;

ET5fl an awareness of the regulatory requirements governing the design of a given medical instrumentation device and how these will impact on the selection and implementation of the design process and design methodology;

ET6fl an awareness and ability to evaluate risks related to the environment, health and safety and where appropriate commercial risk for the underlying medical application area;

5. Engineering Practice

MSc Electronics with Robotic and Control Systems

Graduates will be able to demonstrate:

EP1fl an in-depth understanding of the principles, limitations, electrical and timing characteristics, design and/or implementation, deployment and application of vision systems, media interfaces and instrumentation such as sensors and actuators in the context of robotic and control systems;

EP2fl the ability to use effectively methods of gathering and analysing information and develop a thorough understanding and critical evaluation of current practices used in robotic and control systems; the ability to identify and critically evaluate possible future trends in robotic and control systems;

EP3fl the ability to select, report and apply a suitable design process and design methodology given commercial and industrial constraints for a complex robotic and/or control system problem;

EP4fl understanding of different roles within an engineering team and exercise initiative and personal responsibility within their role;

MSc Electronics with Embedded Systems

Graduates will be able to demonstrate:

EP1fl know-how in the fundamental underlying principles, electrical characteristics, timing characteristics, application and deployment of hardware sub-systems; Micro-Controller-Unit (MCU) power management systems, MCU debugging tools, interface sub-systems, external hardware sub-systems and software development tools to implement low power real-time solutions for a given application area that meets all real-time constraints and functional requirements;

EP2fl the ability to use effectively methods of gathering and analysing information and develop a thorough understanding and critical evaluation of current tools and practices used to develop embedded systems for a given application area; the ability to identify and critically evaluate possible future trends in respect of embedded system development tools;

EP3fl the ability to select, report and apply a suitable design process and design methodology given a range of commercial and industrial constraints for a given embedded system problem;

EP4fl understanding of different roles within an engineering team and exercise initiative and personal responsibility within their role;

MSc Electronics with System-On-Chip Technologies

Graduates will be able to demonstrate:

EP1fl an advanced level of knowledge and understanding of Computer Aided Design (CAD) tools used to enter, simulate and synthesise digital logic and mixed circuit designs including knowledge of logic level abstraction, library based intellectual property (IP) solutions, physical layout, electrical characteristics of the underlying fabrication technology and manufacture and/or configuration of devices;

EP2fl the ability to use effectively methods of gathering and analysing information and develop a thorough understanding and critical evaluation of current tools and practices used to implement System-On-Chip (SoC) solutions for a given application area; the ability to identify and critically evaluate possible future trends in System-On-Chip (SoC) design methodology and development toolsets and discus the advantages this may afford;

EP3fl the ability to select, report and apply a suitable design process and design methodology given commercial and industrial constraints for a given problem;

EP4fl understanding of different roles within an engineering team and exercise initiative and personal responsibility within their role;

MSc Electronics with Medical Instrumentation

Graduates will be able to demonstrate:

EP1fl an advanced level of knowledge and understanding of transducers, biosensors, electrodes, sensor dynamics, electronic circuits and components used to implement diagnostic and therapeutic devices;

EP2fl the ability to use effectively methods of gathering and analysing information and develop a thorough understanding and critical evaluation of current tools and practices used to develop medical instrumentation devices; the ability to identify and critically evaluate possible future trends and demands for medical equipment and the implications this may have on accessibility, risk, society and general patient wellbeing;

EP3fl the ability to select, report and apply a suitable design process and design methodology given commercial and industrial constraints for the implementation of a specific medical device;

EP4fl understanding of different roles within an engineering team and exercise initiative and personal responsibility within their role;

Course structure

This section shows the core and option modules available as part of the course and their credit value. Full-time Postgraduate students study 180 credits per year.

Each of them consists of three taught modules (40 credits each) plus an individual project (60 credits)

MSc Electronics with Embedded Systems

Credit Level 7				
Module code	**Module title**	**Status**	**UK credit**	**ECTS**
E1	Electronics	Core	40	20
E2.2	Embedded Systems	Core	40	20

P1	Project	Core	60	30
One from:				
E2.1	Robotic and Control Systems	Option	40	20
E2.3	System-on-Chip Technologies	Option	40	20
E2.4	Medical Instrumentation	Option	40	20
CN1	Computer Networks	Option	40	20
N2.1	Security	Option	40	20
N2.2	Communication Networks	Option	40	20
N2.3	Cloud Technologies	Option	40	20
TC1	Telecommunications	Option	40	20
C2.1	Digital Signal Processing	Option	40	20
C2.2	Satellite and Broadband Communications	Option	40	20
C2.3	Wireless Technologies	Option	40	20

Please note: Not all option modules will necessarily be offered in any one year.

MSc Electronics with Robotic and Control Systems

Credit Level 7				
Module code	**Module title**	**Status**	**UK credit**	**ECTS**
E1	Electronics	Core	40	20
E2.1	Robotic and Control Systems	Core	40	20
P1	Project	Core	60	30
One from:				
E2.2	Embedded Systems	Option	40	20
E2.3	System-on-Chip Technologies	Option	40	20
E2.4	Medical Instrumentation	Option	40	20
CN1	Computer Networks	Option	40	20
N2.1	Security	Option	40	20
N2.2	Communication Networks	Option	40	20
N2.3	Cloud Technologies	Option	40	20
TC1	Telecommunications	Option	40	20
C2.1	Digital Signal Processing	Option	40	20
C2.2	Satellite and Broadband Communications	Option	40	20
C2.3	Wireless Technologies	Option	40	20

Please note: Not all option modules will necessarily be offered in any one year.

MSc Electronics with System-on-Chip Technologies

Credit Level 7				
Module code	**Module title**	**Status**	**UK credit**	**ECTS**
E1	Electronics	Core	40	20
E2.3	System-on-Chip Technologies	Core	40	20
P1	Project	Core	60	30
One from:				
E2.1	Robotic and Control Systems	Option	40	20
E2.2	Embedded Systems	Option	40	20
E2.4	Medical Instrumentation	Option	40	20
CN1	Computer Networks	Option	40	20
N2.1	Security	Option	40	20
N2.2	Communication Networks	Option	40	20
N2.3	Cloud Technologies	Option	40	20
TC1	Telecommunications	Option	40	20
C2.1	Digital Signal Processing	Option	40	20
C2.2	Satellite and Broadband Communications	Option	40	20
C2.3	Wireless Technologies	Option	40	20

Please note: Not all option modules will necessarily be offered in any one year.

MSc Electronics with Medical Instrumentation

Credit Level 7				
Module code	**Module title**	**Status**	**UK credit**	**ECTS**
E1	Electronics	Core	40	20
E2.4	Medical Instrumentation	Core	40	20
P1	Project	Core	60	30
One from:				
E2.1	Robotic and Control Systems	Option	40	20
E2.2	Embedded Systems	Option	40	20
E2.3	System-on-Chip Technologies	Option	40	20
CN1	Computer Networks	Option	40	20
N2.1	Security	Option	40	20
N2.2	Communication Networks	Option	40	20
N2.3	Cloud Technologies	Option	40	20
TC1	Telecommunications	Option	40	20

C2.1	Digital Signal Processing	Option	40	20
C2.2	Satellite and Broadband Communications	Option	40	20
C2.3	Wireless Technologies	Option	40	20

Please note: Not all option modules will necessarily be offered in any one year.

Learning, teaching and assessment methods

Teaching

The taught portion of the courses is delivered in three highly concentrated 40 credit modules which we call learning modules. The teaching within these modules is delivered in the format of an industrial short course. This delivery style allows students to rapidly gain a full overview of the horizons of the subject matter and furthermore enables the student to achieve a state of relevant functionality without a great deal of elapsed time. This can be especially advantageous if the student is attending on an occasional basis, or has urgent needs of immediate skill in a given topic area at his/her place of work.

Within the taught portion of each module there is adequate time given to “hands-on” practice of concepts and tools taught. The student usually experiences practical in-place application of the knowledge being dispensed during the taught portion of the module on most days. Any assignments and exercises carried out within the taught portion of a module are meant to develop basic capability and, as such, serve as a useful vehicle for sharpening the skills baseline required for undertaking the portfolio of work described within the Independent Learning Package (ILP).

The ILP consists of a collection of short answer, long answer and open ended project based assignments and tasks that must be solved independently by the student. The project based task within the ILP will require the student to exercise and use principles, concepts and technologies within the specialism of the module to design, implement and verify the operation of a complex real system. In some modules the project component maybe in the form of a group project whilst in other modules the project component maybe in the form of an individual project.

Each taught module is allocated 400 hours of study time. Out of this time 70 hours or 10 working days are allocated to the delivery of the taught portion of the module, 16 hours are allocated to additional tutorial sessions and the remaining 314 hours are allocated to the student to work on and complete the ILP. To enable the student to further practice and solidify their understanding of material taught and their abilities in using the relevant tool sets additional tutorials outside of the taught portion of the module are provided. These tutorials provide just in time practice sessions during the ILP period of the module. The ILP is where the remaining learning takes place, where abundant ‘soak-time’ to solve the portfolio of work described within the ILP package document is given. The performance of work carried out for the ILP can take place at the university, within the students place of work or at their home.

Assessment

Assessment of Learning Modules

The assessment for the learning modules is formed by setting a portfolio of work known as an Independent Learning Package (ILP) that the student must complete. The ILP typically consists of short answer, long answer and open ended project based assignments and small tasks. The student must submit their completed ILP work in the form of an ILP report that will contain a critical, reflective and detailed description of the independent work carried out by the student and the results achieved by the student.

Unlike the assignments given in the ILP exercises carried out in the taught portion of a learning module are not assessed, these exercises are meant to develop basic capability and, as such, serve as a useful vehicle for sharpening the skills baseline for undertaking the associated Independent Learning Package (ILP) – often through keen competition within the class. In summary, the taught portion of a module is not explicitly subject to assessment, whereas ILPs are.

Assessment is carried out when the student presents himself/herself for examination. This process has two phases: submission of all supporting written evidence (worked problems, design and simulation results, software programs, written reports and the like) in the form of an ILP report, followed by attendance for an oral defence of the work detailed in the ILP report. An ILP Review Panel, consisting of at least two members of staff, will be empowered to determine the level of achievement of the student by giving a 'Pass with Distinction', 'Pass with Merit', 'Pass' or 'Fail' judgement after thorough scrutiny of the written evidence and hearing the oral defence and to make a recommendation to the Assessment Board.
It will be the principal task of the panel to assess the student's competence through carrying out the assigned work, with respect to the norms of professional-level competence which pertain to that subject. The result is a 'Pass with Distinction', 'Pass with Merit', 'Pass' or 'Fail' judgement. Students must achieve at least a 'Pass' to be awarded the credits for that module. Specifically the criteria used for assessment are the learning outcomes of each Learning Module. In order to pass a module:

1. The student must demonstrate achievement in **each** and **every** learning outcome either through the written ILP submission or during the oral examination;
2. The majority of the required ILP work must be completed satisfactorily as viewed through the written submission;
3. The majority of the candidate's responses in the examination must be correct;
4. The oral examination must verify that the student has ownership of the ILP material and is able to defend it effectively.

The major purposes of the oral examination are to:

- verify that the student has ownership of the written submission;
- clarify the student's degree of subject authority in areas where this has not been established through the written submission;
- explore the student's mental flexibility in applying advanced levels of technical knowledge to new applications;
- probe the student's depth of understanding and capacity for higher level critical analysis;
- allow the student to demonstrate interactive communication skills.

Failure to submit the written material by the deadline acknowledged by the student or absence from the oral examination, without reasonable cause supported by evidence submitted in accordance with the University's mitigating circumstances procedures, will be considered a failure of the module. Therefore, a subsequent late submission or attendance at a re-scheduled oral examination would constitute a re-assessment. Students experiencing difficulties should contact their Personal Tutor, the Module Leader or the Course Leader for advice, well before the deadline.

If the candidate has passed the module at the first attempt and is not being reassessed, and the candidate's submitted ILP work and performance during the examination are deemed to be meritorious, the panel will flag the pass as being "With Merit". This is exemplified by:
1. the student demonstrating subject authority with reasonable confidence and fluency;
2. a virtually complete written submission, on time, with few mistakes;
3. little or no help required in handling technical questioning during the oral examination;
4. the ability to conceptualise and critically evaluate their subject matter.

If the candidate has passed the module at the first attempt and is not being reassessed, and the candidate's submitted ILP work and performance during the examination are deemed to be outstanding, the panel will flag the pass as being "With Distinction". This is exemplified by:
1. the student demonstrating a complete subject authority with confidence and fluency;
2. a virtually complete written submission, on time, with no significant mistakes;
3. the ability to handle technical questions during the oral examination with confidence and fluency;
4. the ability to demonstrate in-depth know-how in their subject matter;
5. the student showing evidence of being able to extend and apply the taught material to new situations with alacrity.

The panel may make a recommendation of 'Pass', 'Pass with Merit' or 'Pass with Distinction' conditional upon minor modifications to the submitted ILP work being completed.

Project Assessment

Completion of the Individual Project is signalled by submission of the Project thesis for assessment. A Project Review Panel receives an oral defence of the project work and, incorporating its assessment of the thesis, decides upon credit award. Again, this is a 'Pass with Distinction', 'Pass with Merit', 'Pass' or 'Fail' decision.

Failure to submit the thesis by the deadline agreed by the student or absence from the oral examination, without reasonable cause supported by evidence submitted in accordance with the University's special circumstances procedures, would be considered a failure of the module. Therefore, a subsequent late submission or attendance at a re-scheduled oral examination will constitute a re-assessment. Students experiencing difficulties should contact their Supervisor, their Personal Tutor the Project Co-ordinator or the Course Leader for advice, well before the deadline. For further details, please refer to Section 6 of the handbook of academic regulations. You can also find information regarding assessment in section 5 of the essential Westminster Information Guide published by the university.

If the candidate has passed the Project at the first attempt and is not being reassessed, and the candidate's project thesis and performance during the examination are judged meritorious, the panel will flag the pass as being "With Merit". This would be exemplified by:
1. a significant amount of independent work undertaken during the project period;
2. the candidate demonstrating subject authority with reasonable confidence and fluency;
3. the ability to critically evaluate the work undertaken;
4. good written skills in terms of drafting and self-editing;
5. a thesis submitted on time, with few mistakes;
6. little or no help required in handling technical questioning during the oral examination.

If the candidate has passed the Project at the first attempt and is not being reassessed, and the candidate's project thesis and performance during the examination are judged outstanding, the panel will flag the pass as being "With Distinction". This would be exemplified by:
1. a substantial amount of independent work undertaken during the project period;
2. the candidate demonstrating a complete subject authority with confidence and fluency;
3. the ability to conceptualise and critically evaluate the work undertaken at a high level;
4. excellent written skills in terms of drafting and self-editing;

5. a thesis submitted on time, with no significant mistakes;
6. the ability to handle technical questions during the oral examination with confidence and fluency;
7. evidence of the student extending the original scope of the project.

A structured procedure will be employed in grading both the thesis and performance during the oral presentation. There will be at least three members on a Project Review Panel: Supervisor, Assessor and Moderator. The Project Supervisor has greatest familiarity with the topic and the volume, depth and quality of the student's work. The Assessor, like the Supervisor, will have studied the thesis prior to the presentation. By contrast, the Moderator judges solely on the quality and accuracy of the oral presentation and the candidate's ability to conduct a credible defence during questioning. The Moderator, who is present at a significant number of the project oral examinations, has the additional responsibility to adjudicate and harmonise the panel's findings with those resulting from other Project presentations. Following the examinations, the Moderators meet as a panel to finalise the harmonisation of results across the cohort and to resolve any borderline cases.

As with the learning modules, the learning outcomes of the Project form the basis of the assessment criteria. No explicit weighting is placed on the written report and on the oral examination. The two forms of assessment collectively ensure that the learning outcomes of the Project are achieved for it to be passed. However, the oral examination has certain specific functions which include:

- the opportunity for the student to demonstrate presentation and interactive communication skills;
- verification that the project is the student's own work;
- clarification of the student's degree of subject authority in areas where this has not been established within the report;
- probing the student's depth of understanding of the project;
- exploring the student's mental flexibility in extending the reported project work to new areas.

Penalties for Late Submission of Coursework

The University operates a two-tier penalty system for late submission of ILP and project reports. This regulation applies to all students registered for an award, irrespective of their level of study. All University coursework deadlines are scheduled between Monday and Thursday inclusive.

If the report is submitted within 24 hours of the deadline, a Distinction grade cannot be awarded and a Merit grade cannot be awarded unless the work was, in fact, of Distinction quality. If the report is submitted more than 24 hours or more than one working day after the specified deadline you will be given a grade of 'fail' for the work in question.

Late work and any claim of mitigating circumstances relating to coursework must be submitted at the earliest opportunity to ensure as far as possible that the work can still be marked. Late work will not normally be accepted if it is received more than five working days after the original coursework deadline. Once the work of other students has been marked and returned, late submissions of that same piece of work cannot be assessed.

Reassessment of Learning Modules and the Project

Normally, no student shall be permitted to attempt a Learning Module more than twice other than when sanctioned by the Mitigated Circumstances Board. The Project can only be *assessed* twice other than when sanctioned by the Mitigated Circumstances Board. Following failure of the first assessment of the project, the student may either be reassessed or to retake the Project in entirety at the discretion of the Assessment Board. The Project cannot be retaken following reassessment nor can a second attempt be reassessed.

Reassessment may take the form of a re-submission of all or part of the ILP written submission or project report;

OR a repeat viva voce examination;

OR both.

The award of credits with Merit or Distinction cannot be made following reassessment.

The Assessment Boards

Wherever possible, there will be a joint combined Subject and Conferment Board for the following courses:

- Electronics with Robotic and Control Systems,
- Electronics with Embedded Systems,
- Electronics with System-on-Chip Technologies,
- Electronics with Medical Instrumentation,
- Telecommunications with Digital Signal Processing,
- Telecommunications with Satellite and Broadband Technologies,
- Telecommunications with Wireless Technologies,
- Computer Networks with Security,
- Computer Networks and Communications,
- Computer Networks with Cloud Technologies

The role of the Subject/Conferment Board is to confirm the recommendations of the ILP and Project Review Panels in the award of credits for modules passed and to recommend the award of MSc, PgDip and PgCert and whether these awards should be conferred with Merit or Distinction.

The Mitigating Circumstances Board will take into account any mitigating circumstances, submitted by the student, which may have affected the student's performance in one or more modules. Where the Mitigating Circumstances Board is satisfied that the mitigating circumstances affected the student's performance in that module assessment, it will recommend to the Subject/Conferment Board to compensate for the mitigating circumstances if the student has marginally failed or to allow deferred assessment.

The Subject/Conferment Board may make aegrotat awards in accordance with the Assessment Regulations of the University.

Role of the External Examiners

A panel of typically three External Examiners shall be appointed to these courses in accordance with the regulations of the University. The expertise of the panel should collectively span the subject areas of the courses being considered. The principal roles of the External Examiners are to oversee and certify:

1. the academic standards and advise on the operation of the core and option Learning Modules;
2. the individual projects of students;
3. the operation of the assessment boards and the overall standard of the awards.

The External Examiners will have access to all matters pertinent to the courses, including ILP reports of assessment retained by the Module Leaders. However – in view of the multitude of asynchronous milestones being completed by various students – it will not generally be practical to consult on anything other than a macroscopic, retrospective basis.

It is standard practice to record all oral examinations and to archive these recordings for at least one year. In this way, the External Examiners will be able to reconstruct and evaluate all factors which have contributed to any individual student's assessment, thereby having unimpeded oversight of every aspect of course operation.

The duties of the External Examiners will include:

- sampling of ILP assignments to ensure the calibre of their content and the standard of the work carried out by the students;
- sampling of project theses to ensure that a postgraduate standard is being maintained;
- viewing samples of video records of oral examinations for ILPs and projects;
- attending assessment boards;
- providing an annual report to the University on the operation of the course and assessment procedures.

Academic Regulations

The MSc Electronics with

- Embedded Systems
- Robotic and Control Systems
- System-on-Chip Technologies
- Medical Instrumentation

and their intermediate awards operate in accordance with the University's Academic Regulations and the UK Quality Code for Higher Education Part A: Setting and Maintaining Academic Standards, Frameworks for Higher Education Qualifications of UK Degree-Awarding Bodies document published by the Quality Assurance Agency for Higher Education (QAA) in October 2014.

All students should make sure that they access a copy of the current edition of the general University handbook called Essential Westminster, which is available at http://www.westminster.ac.uk/study/current-students/resources/essential-westminster. The following regulations should be read in conjunction with Section 18: Modular Framework for Postgraduate Courses and relevant sections of the current Handbook of Academic Regulations, which is available at westminster.ac.uk/academic-regulations

Award of Master of Science (MSc) Degree

To be eligible for the award of Master of Science (MSc) Degree, a student must have:

(a) obtained a minimum of 180 credits accrued from the Project and three taught modules forming their course, normally including all the core taught modules;
(b) attempted modules worth no more than 240 credits

Note: A first attempt of any module will count as an attempt, and a re-attempt of any module that a student has failed will count as a further, separate attempt. Reassessment following referral at the first sit will not count as a further separate attempt.

The MSc Degree may be awarded with Merit normally if the student has:
(a) passed the Project at the first attempt without reassessment;
(b) not failed, or been re-assessed in more than one taught module;
(c) accrued at least
    (i) 100 credits with Merit, or
    (ii) 80 credits with Distinction

The MSc Degree may be awarded with Distinction normally if the student has:
(a) passed the Project at the first attempt without reassessment;
(b) not failed, or been re-assessed in more than one taught module;
(c) accrued at least
    (i) 180 credits with Merit or Distinction including 100 credits with Distinction, or

(ii) 140 credits with Distinction.

Award of the Postgraduate Diploma (PgDip)

To be eligible for the award of a Postgraduate Diploma (PgDip), a student must have obtained a minimum of 120 credits accrued from the modules forming their course, including:

- a core module, and
- a second core module or the Project

, ,
The Postgraduate Diploma may be awarded with Merit normally if the student has accrued 120 credits at the first attempt including 80 credits with Merit or Distinction

The Postgraduate Diploma may be awarded with Distinction normally if the student has accrued: 120 credits at the first attempt with Merit or Distinction including 80 credits with Distinction

Award of a Postgraduate Certificate (PgCert)

To be eligible for the award of a Postgraduate Certificate, a student must have a minimum of 60 credits

The Postgraduate Certificate may be awarded with Merit normally if the student has accrued 60 credits at the first attempt with Merit or Distinction

The Postgraduate Diploma may be awarded with Distinction normally if the student has accrued 60 credits at the first attempt with Distinction

A student registered for the MSc award may elect to submit his/her credits for the award of a Postgraduate Certificate or Postgraduate Diploma but, by so doing, relinquishes the right to submit those credits for the award of an MSc (or Postgraduate Diploma if submitting for Postgraduate Certificate) at a later date.

Statutes of Limitations

The time limit for a student to complete their programme of study shall be as follows

	Full-Time	Part-Time
MSc	4 years	5 years
PgDip	2 years	4 years
PGCert	1 year	2 years

Where a student, having attempted modules worth more than 80 credits, has failed modules worth ***more*** than **1/3** of total credits attempted, or has failed and cannot have a further attempt at a core module, and the Subject/Conferment Board judges that the student will not achieve the next named award to which the student would be eligible within the maximum period of registration, then the board may exclude the student from the programme of study. Alternatively the Board may recommend that the student transfer to the Postgraduate Diploma programme (and consequently not undertake the Individual Project module). Normally, this would not be done if the student has passed at least **three** taught modules at the first attempt without reassessment.

Support for students

Upon arrival, an induction programme will introduce students to the staff responsible for the course, the campus on which they will be studying, the Library and IT facilities and to the Faculty Registry. Students will be directed to where they can find an on-line Course Handbook, which provides detailed information about the course. Students are allocated a personal tutor who can provide advice and guidance on academic matters.

Learning support includes four libraries, each holding a collection of resources related to the subjects taught at their Faculty. Students can search the entire library collection online through the Library Search service to find and reserve printed books, and access electronic resources (databases, e-journals, e-books).

Students can choose to study in the libraries, which have areas for silent and group study, desktop computers, laptops for loan, photocopying and printing services. They can also choose from several computer rooms at each campus where desktop computers are available with the general and specialist software that supports the courses taught at their Faculty. Students can also securely connect their own laptops and mobile devices to the University wireless network.

The University uses a Virtual Learning Environment called Blackboard where students access their course materials, and can communicate and collaborate with staff and other students.

At University level, Services for Students provide advice and guidance on accommodation, financial and legal matters, personal counselling, health and disability issues, careers and the chaplaincy providing multi-faith guidance. The International Office provides particular support for international students. The University of Westminster Students' Union also provides a range of facilities to support all students during their time at the University.

Reference points for the course

Internally

Staff research and development in Electronic systems design and application areas

Industrial Advisory Panel

University of Westminster Mission Statement

University teaching and learning policies

University quality assurance handbook and Modular Frameworks.

Handbook of Academic Regulations.

Faculty of Science and Technology teaching, learning and assessment strategies

Externally

UK-SPEC (Engineering Council's UK Standard for Professional Engineering Competence) The Accreditation of Higher Engineering Programmes, 3rd edition, 2014

IET (Institution of Engineering and Technology) Academic Accreditation Guidelines, 2015

Accreditation of Higher Education Programmes (AHEP) third edition, 2014

QAA Subject Benchmark for Engineering, draft document, 2014

Professional body accreditation

Our aim is to obtain IET accreditation for the MSc Degree Programmes detailed in this document.

Quality management and enhancement

Course management

Course approval, monitoring and review

The course was initially approved by a University Validation Panel in 2015. The panel included internal peers from the University and external subject specialists from academia and industry to ensure the comparability of the course to those offered in other universities and the relevance to employers. Periodic course review helps to ensure that the curriculum is up-to-date and that the skills gained on the course continue to be relevant to employers.

The course is monitored each year by the Faculty to ensure it is running effectively and that issues which might affect the student experience have been appropriately addressed. Staff will consider evidence about the course, including the outcomes from each Course Committee, evidence of student progression and achievement and the reports from external examiners, to evaluate the effectiveness of the course. The Annual Monitoring Sub-Committee considers the Faculty action plans resulting from this process and the outcomes are reported to the Academic Council, which has overall responsibility for the maintenance of quality and standards in the University.

Student involvement in Quality Assurance and Enhancement

Student feedback is important to the University and student views are taken seriously. Student feedback is gathered in a variety of ways. The most formal mechanism for feedback on the course is the Course Committee. Student representatives will be elected to sit on the Committee to represent the views of their peer group in various discussions. The University and the Students' Union work together to provide a full induction program so that the elected student representative fully understands their role and the role of the Course Committee.

All students are invited to complete a Module Feedback Questionnaire before the end of each module. The feedback from this will inform the module leader on the effectiveness of the module and highlight areas that could be enhanced. The University also has an annual Student Experience Survey, which elicits feedback from students about their course and University experience.

Students meet with review panels when the periodic review of the course is conducted to provide oral feedback on their experience on the course. Student feedback from course committees is part of the Faculty's' quality assurance evidence base.

For more information about this suite of courses:

Dr G Charalambous charalg@westminster.ac.uk

Please note: This programme specification provides a concise summary of the main features of the course and the learning outcomes that a student might reasonably be expected to achieve and demonstrate if s/he takes full advantage of the learning opportunities that are provided. This specification should be read in conjunction with the Course Handbook provided to students and Module Handbooks, which provide more detailed information on the specific learning outcomes, content, teaching, learning and assessment methods for each module.