Programme Title: MSc in Biomedical Engineering with Imaging and Instrumentation

Programme Specification

Awarding Body/Institution	Queen Mary, University of London
Teaching Institution	Queen Mary, University of London
Name of Final Award and Programme Title	MSc in Biomedical Engineering with Imaging and Instrumentation
Name of Interim Award(s)	
Duration of Study / Period of Registration	1 year full time
QM Programme Code / UCAS Code(s)	HBS6
QAA Benchmark Group	Masters degrees in Engineering
FHEQ Level of Award	Level 7
Programme Accredited by	N/A
Date Programme Specification Approved	N/A
Responsible School / Institute	School of Engineering & Materials Science

Schools which will also be involved in teaching part of the programme

School of Electronic Engineering & Computer Science

Institution(s) other than Queen Mary that will provide some teaching for the programme

Programme Outline

Biomedical Engineering is a field of engineering that relies on highly inter- and multi-disciplinary approaches to research and development, in order to address biological and medical problems. Specialists in this area are trained to face scientific and technological challenges that significantly differ from those related to more traditional branches of engineering. Nevertheless, at the same time Biomedical Engineering makes use of more traditional engineering methodologies and techniques, which are adapted and further developed to meet specifications of biomedical applications.
This MSc programme covers the following topics:
• Fundamentals of human physiology;
• Ethics and regulatory affairs in the biomedical field;
• Medical imaging modalities and digital signal processing, their uses and challenges;
• Analysis and design of instrumentation electronics present in a wide range of medical devices;
• Instrumentation and technologies used for clinical measurements;
• Design, analysis and evaluation of critical systems in the context of clinical monitoring, including safety;
• Origin of biological electricity, measurement of bioelectric signals, principles of bioelectric stimulation, and their applications.
Applications are welcome from students with a background in Engineering or Physics.

Programme Title: MSc in Biomedical Engineering with Imaging and Instrumentation

The programme is a joint effort of the School of Engineering and Materials Science and the School of Electronic Engineering and Computer Science. It has strong roots within the well-recognised expertise of academics from the two Schools that deliver the lectures, who have international standing in cutting-edge research on Imaging and Instrumentation. This fact ensures that the programme is delivered with the highest standards in the field. The students also benefit from access to state-of-the-art facilities and instrumentation while undertaking their research projects.

The programme is designed with a careful balance of diversified learning components, such that, on completion of their studies, the postgraduates acquire extensive knowledge and skills that make them able to undertake careers in a wide range of professional ambits within the biomedical field, including health care services, industry and scientific research.

Aims of the Programme

This MSc programme aims to prepare specialists with advanced knowledge and transferable skills in the field of Biomedical Engineering with a special focus on the areas of Imaging and Instrumentation.

Further aims of the programme are as follow.

1. Teaching advanced experimental, computational and analytical techniques applicable to Biomedical Engineering, in particular in Imaging and Instrumentation, in order to provide an advanced base of knowledge and skills
2. Teaching advanced biological and medical experimental techniques applicable to medicine and general healthcare.
3. Teaching modern biomedical techniques used in bioengineering, medical and healthcare units.
4. Implementation of taught material through a research/design project.
5. Providing students with insight into advanced developments and associated ethical and legal issues for their implementation in medical practice.
6. Enabling students to participate in advanced research and industrial developments in Biomedical Engineering.
7. Introducing the students to selected issues in commerce and law that they may encounter in industry.

What Will You Be Expected to Achieve?

Students who complete the degree programme will be expected to have:

Academic Content:	
A1	Knowledge of the scientific and engineering principles necessary to underpin their education in the field of Biomedical Engineering with a special focus on Imaging and Instrumentation
A2	Ability to critically evaluate existing analytical and experimental techniques and propose practical methods for their improvement
A3	An in-depth knowledge of the field of Biomedical Engineering with a special focus on Imaging and Instrumentation, so as to be able to find practical solutions to biomedical engineering problems
A4	Knowledge of the fundamentals of physiology and the ability to apply these to biomedical engineering applications
A5	An understanding of how engineers and clinicians interface within the medical sector and the technological requirements of that sector
A6	Knowledge of the regulatory framework governing the development of new Biomedical Engineering products, with with a special focus on Imaging systems and Instrumentation

Queen Mary
University of London

Programme Title: MSc in Biomedical Engineering with Imaging and Instrumentation

	Disciplinary Skills - able to:
B 1	Understand appropriate fundamental engineering principles related to applications in Biomedical Engineering with a special focus on Imaging and Instrumentation
B 2	Apply engineering principles to a range of medically related applications
B 3	Recognise the responsibilities of the professional biomedical engineer
B 4	Use fundamental knowledge to evaluate new and emerging medically related technologies
B 5	Use appropriate technical and non-technical language to effectively communicate and interface with clinicians to formulate medical problems from an engineering viewpoint
B 6	Learn new theories, concepts, methods etc. in unfamiliar situations
B 7	Develop, monitor and update a plan, to reflect a changing operating environment
B 8	Plan and perform safe experimental work in laboratory settings
B 9	Work effectively with computing tools for data analysis and processing, as well as modelling, simulation and design
B 10	Exercise professional judgement in medically-related problem solving, considering functional, ethical and economic issues
B 11	Apply initiative and competence to the design, development and analysis of Biomedical Imaging systems and Instrumentation

	Attributes:
C 1	Be able to understand both the application and limitation of computational and experimental techniques available to biomedical engineers
C 2	Engage critically with knowledge, and apply it in a rigourous way
C 3	Be able to carry out a substantial piece of individual work whose structure and content is largely self-determined
C 4	Have the ability to analyse and solve problems individually and in groups
C 5	Have the ability to communicate knowledge and ideas verbally and in written reports
C 6	Use communications technologies competently to engage with a range of audiences
C 7	Critically evaluate the reliability of different sources of information
C 8	Use information for evidence based decision making
C 9	Use quantitative data confidently and competently
C 10	Develop the necessary transferable skills to be effective in the workplace
C 11	Develop awareness of Health and Safety

Queen Mary
University of London

Programme Title: MSc in Biomedical Engineering with Imaging and Instrumentation

How Will You Learn?

Teaching materials are delivered through a combination of lectures, laboratory practicals, and a variety of coursework. Students complete a substantial research project in the field of Biomedical Engineering with special focus on Imaging and Instrumentation.

The project consists of an individual piece of work, under the supervision of an academic member of staff. It can take either one, or a combination, of the following forms: (i) an experimental investigation; (ii) a computational exercise; (iii) the development of a piece of experimental apparatus; (iv) a design study; (v) a theoretical analysis; (vi) a review of a topic of current interest.

How Will You Be Assessed?

Assessment is continuous throughout the degree, with written reports, projects, presentations, group work and exams (exams take place in the summer only). The degree programme has eight modules per year split over two semesters, and most are assessed by a combination of coursework and an end of year exam. The research project will be assessed by the submissions of a written report and an oral examination by two examiners, including a short presentation and question and answers session.

How is the Programme Structured?

The Programme has a duration of one year, full time.
Teaching takes place between September and April.
Total 180 credits have to be taken: 120 credits of taught modules and 60 credits from a research project. The 120 credits of taught modules are obtained from 8 taught modules of 15 credits each: 60 credits are taught in the first semester from September to December and a further 60 credits are taught in the second semester from January to April.
The 60 credit research project runs until the end of August. The preparation for the project begins in the module 'Research Methods and Experimental Techniques in Engineering' in the first semester.
Exams take place in May - June.

PROGRAMME STRUCTURE

Compulsory modules:
• Ethics and Regulatory Affairs (SEMS module DENM702)
• Research Methods and Experimental Techniques in Engineering (SEMS module DENM014)

Specialising modules:
• Fundamentals of Digital Signal Processing (EECS module ECS707P)
• C++ for Image Processing (EECS module ECS756P) OR Electronics (New level-7 EECS module)
• Surgical Techniques and Safety (SEMS module MELM003)
• Clinical Measurements (SEMS module DENM024)
• Principles and Applications of Medical Imaging (SEMS module DENM029)
• Real-time and Critical Systems (EECS module ECS727P) OR Principles and Applications of Bioelectricity (New SEMS module DENM302) OR Physiology for Medical Engineers (SEMS module MELM009)

Programme Title: MSc in Biomedical Engineering with Imaging and Instrumentation

Academic Year of Study   1

Module Title	Module Code	Credits	Level	Module Selection Status	Academic Year of Study	Semester
Physiology for Medical Engineers	MELM009	15	7	Elective	1	Semester 2
Research Methods and Experimental Techniques in Engineering	DENM014	15	7	Compulsory	1	Semester 1
Ethics and Regulatory Affairs	DENM702	15	7	Compulsory	1	Semester 2
Fundamentals of Digital Signal Processing	ECS707P	15	7	Compulsory	1	Semester 1
C++ for Image Processing	ECS756P	15	7	Elective	1	Semester 1
Electronics	ECS777P	15	7	Elective	1	Semester 1
Clinical Measurements	DENM024	15	7	Compulsory	1	Semester 2
Principles and Applicationsof Medical Imaging	DENM029	15	6	Compulsory	1	Semester 2
Real-time and Critical Systems	ECS727P	15	7	Elective	1	Semester 2
Principles and Applications of Bioelectricity	DENM302	15	7	Elective	1	Semester 2
Biomedical Engineering Project	DENM006	60	7	Core	1	Semesters 1-3
Surgical Techniques and Safety	MELM003	15	7	Compulsory	1	Semester 1

What Are the Entry Requirements?

Minimum of a 2:2 (55% or higher) degree or the equivalent international undergraduate degree.

We welcome applications from students with a background in Engineering or Physics.

English at IELTS 6.5 (if needed) – details of equivalent English Qualifications available on the QMUL website.

How Do We Listen and Act on Your Feedback?

The Staff-Student Liaison Committee (SSLC) provides a formal means of communication and discussion between the students

Queen Mary
University of London

and the two Schools that organise this MSc programme. The committee consists of student representatives together with appropriate representation from staff within the two Schools. It is designed to respond to both the general needs of students, and subject specific concerns, as well as act as a forum for discussing programme and module developments. Staff-Student Liaison Committees meet regularly through the year.

The chair of the SSLC sits on the School's Education and Learning Committee, which advises the School's Director of Taught Programmes on all matters relating to the delivery of taught programmes at School level, and ensures that student feedback is fed into the reviewing of modules and programmes. Student views are also incorporated in the Committee's work in other ways, such as through the PG survey, student module evaluations and module forums. We also use the forums to listen to student feedback on an individual module basis and develop materials and support classes to address comments or requests suggested in the forum.

All Schools operate an Annual Programme Review (APR) of their taught undergraduate and postgraduate provision. APR is a continuous process of reflection and action planning which is owned by those responsible for programme delivery; the main document of reference for this process is the Taught Programmes Action Plan (TPAP) which is the summary of the School's work throughout the year to monitor academic standards and to improve the student experience.

Academic Support

Academic support for individual modules is the responsibility of the module organiser and co-organiser(s). These are supported by Teaching Assistants and post-graduate students, many of whom will have studied the modules themselves as undergraduates in the School. In addition there is technician support available for practical sessions.
Academic support for the programme as a whole, including choosing optional modules and possible transfer between programmes is provided in the first instance by the Programme director, who also has overall responsibility for the programme structure. The Programme Director in turn reports to the relevant Discipline Teaching Group in the School, the Chair of which is a member of the School's Education and Learning Committee.
We additionally have a School Office, with many student facing staff available to support student learning and one full time Student Support Officer. These staff members will help with coursework submission, time tabling concerns and other general administration as well as providing pastoral support and further guidance on dealing with extenuating circumstances. We also have staff designated to support students in achieving industrial placements and providing careers advice.

Programme-specific Rules and Facts

The Programme operates under the standard QMUL rules for MSc programmes.

Specific Support for Disabled Students

Queen Mary has a central Disability and Dyslexia Service (DDS) that offers support for all students with disabilities, specific learning difficulties and mental health issues. The DDS supports all Queen Mary students: full-time, part-time, undergraduate, postgraduate, UK and international at all campuses and all sites.

Students can access advice, guidance and support in the following areas:
• Finding out if you have a specific learning difficulty like dyslexia
• Applying for funding through the Disabled Students' Allowance (DSA)
• Arranging DSA assessments of need
• Special arrangements in examinations
• Accessing loaned equipment (e.g. digital recorders)
• Specialist one-to-one "study skills" tuition
• Ensuring access to course materials in alternative formats (e.g. Braille)

Queen Mary
University of London

Programme Title: MSc in Biomedical Engineering with Imaging and Instrumentation

• Providing educational support workers (e.g. note-takers, readers, library assistants)
• Mentoring support for students with mental health issues and conditions on the autistic spectrum.

Links With Employers, Placement Opportunities and Transferable Skills

We place a strong emphasis on supporting our students in achieving quality graduate positions at the end of their degrees. In the first year, all students take a transferable skills module, designed to both support them through the transition to university life, and also introduce the important employability skills they will need in later life. We run an extensive range of employability training events, with weekly timetabled careers slots and field trip visits to more than 20 collaborating companies. Our relationships with both the Careers Group and Student Services are strong in SEMS and EECS, and we co-deliver our training in study skills and career development for maximum benefit.

SEMS has run Industrial Liaison Forums (ILFs) each academic year since the School was formed in 2007. Since 2010, the Autumn event is focused on encouraging more industrial participation in our research programmes, rewarding excellence by allowing companies to present student prizes for academic excellence across the School and also as a way of allowing companies and our students to interact through themed panel sessions and a careers fair. The Spring event aims to showcase our best third year project students and all of our group MEng projects. This event again allows extensive networking opportunities between employers and placement providers with all students. Typically these events are attended by over 50 companies including regular student prizes sponsors: Tata Steel, Eaton Industries, JRI, GSK, RollsRoyce, Apatech, Morgan Cruicible, ARTIS, NPL, TWI, Becker Coatings; Advanced Healthcare Ltd & Apatech. Many of these companies are also actively engaged in student projects and in addition to these our events are also attended by additional companies that also collaborate with projects such as: Jaguar Land Rover, Alcoa, Perryman, DSTL, BAe, Airbus, Corin, DePuy, Baxter's Healthcare, Norman Foster Partners and many others. In recent times we have extended these events to encourage participation from our more recent alumni as well.

These forums have a direct impact by encouraging employers to sponsor and support the student projects and to provide real engineering case studies to engage the students throughout the curriculum. Many of these companies also support the lecture programmes in individual modules.

Programme Specification Approval

Person completing Programme Specification	Dr Federico Carpi
Person responsible for management of programme	Dr Federico Carpi
Date Programme Specification produced/amended by School Learning and Teaching Committee	13 Jan 2016
Date Programme Specification approved by Taught Programmes Board	N/A

Queen Mary
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