PROGRAMME SPECIFICATION

Degrees:

Programme Title	Final Award	Duration of study/ years	Programme & route codes	Level
Biomedical Engineering	MSc	1	PMSF-QMENNG1- PSBMEZ	7

Ownership	
Awarding institution:	Queen Mary University of London
Teaching institution	Queen Mary University of London
Academic Department(s) involved in programme delivery	School of Engineering and Materials Science
Main location(s) of study	Mile End Road, London
External references	
QAA Benchmark Group	Engineering
External Accreditor (if applicable)	Institution of Mechanical Engineers, Institute of Physics & Engineering in Medicine and Institute of Materials, Minerals & Mining
Accreditation received	2018 (IMechE)
Accreditation renewal	IMechE (2024)

Specification Details	
Programme Lead	Prof Karin Hing
Student cohorts covered by specification	2025 entry
Date of introduction of programme	September 2019
Date of programme specification / amendment	15 November 2024
Approval by School	15 November 2024
Submitted to Directorate of Governance & Legal Services	16 November 2024

1. Programme Overview

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.

The programme has strong roots within the well-recognised expertise of the academics that deliver the lectures, who have international standing in cutting-edge research in a diversity of topics of Biomedical Engineering. This fact ensures that the programme is delivered with the highest standards in the field.

This MSc programme aims to prepare you to become a specialist with advanced knowledge and transferable skills in the field of Biomedical Engineering with a personalised curriculum of study through one of the specified pathways. This is aimed at offering the possibility of choosing a coherent set of modules, with flexibility within a diverse offer, so as to meet specific interests and expectations, as well as career plans. You can take advantage of support offered by the School to receive a help on how to optimally shape your personalised curriculum.

You will be able to select a balanced combination of modules that will allow you to undertake careers in a wide range of professional areas of interest within the biomedical field, including health care services, industry and scientific research. The programme is set up to allow students to follow a pathway, in one of 4 areas, namely, Clinical Engineering, Biomechanics, Artificial Intelligence and Digital Healthcare, Biomaterials. .

A 90 credit research project is to be undertaken using our research activities and our state of the art facilities. You will benefit from access to state-of-the-art facilities and instrumentation while undertaking their research projects. Several high performance computing clusters owned by the university support a full spectrum of computational research. Our well equipped laboratories include a wide range of tissue engineering, human performance, mechanical testing and materials synthesis and characterisation labs.

The Biomedical Engineering MSc programme aims to prepare specialists with advanced skills in experimental techniques, computational modelling, and in depth understanding of biomedical engineering approaches to medical and health problems. Depending on students' preferences, the programme will place particular emphasis on bioengineering approaches to either cell and tissue therapies, imaging and instrumentation, more traditional applications in everyday health care and orthopaedics, regulatory practice, or a combination of these areas.

The detailed aims of the programme are to:

- Teach advanced experimental, computational and analytical techniques applicable to Biomedical Engineering in order to provide an advanced base of knowledge and skills
- Teach advanced biological and medical experimental techniques applicable to medicine and general healthcare.
- Teach modern biomedical techniques used in bioengineering, medical and healthcare units.
- Implement taught material through a research/design project.
- Provide students with insight into advanced developments and associated ethical and legal issues for their implementation in medical practice.
- Enable students to participate in advanced research and industrial developments in Biomedical Engineering.

2. Learning outcomes for the programme

In this degree programme we place strong emphasis not only on the technical content of our modules, but also on cross disciplinary skills vital for an engineer to be effective in the work-place. We embed these skills in the technical modules on the programme, to ensure that the technical knowledge and understanding works as you progress through your degree, and also to allow you to graduate with skills you can apply to a range of future careers.

Following completion of this programme, you will have developed skills to work in a wide range of industries that develop, design, and maintain Biomedical Engineering systems from full systems to component design and analysis. You will develop knowledge in this field to an advanced level, in both experimental and computational areas, depending on your interests and the pathway you select. You will develop the ability to critically evaluate existing analytical and experimental techniques and propose practical methods for their improvement in the field, so as to be able to find practical solutions to biomedical engineering problems with sufficient knowledge of the fundamentals of physiology. You will start to understand how engineers and clinicians interface within the medical and biological sectors and the technological requirements of those sectors including knowledge of the regulatory framework governing the development of new products. Ultimately this degree will support you in applying your initiative and competence to the design, development and analysis of biomedical materials, devices and systems. In addition you will have been given an ideal preparation for undertaking a PhD in a related discipline.

A1	**Core scientific principles**. Understand the core engineering, scientific and mathematical principles needed to underpin Biomedical Engineering professions.
A2	**Disciplinary concepts.** Understand, apply and critique a broad range of disciplinary concepts related to Biomedical Engineering.
A3	**Problem solving.** Apply engineering approaches to solve a wide range of problems, relating to risks, costs, safety, reliability, aesthetics and environmental impact.
A4	**Key technologies.** Fundamentally understand state-of-the-art technologies related to Biomedical Engineering.
A5	**Systems design and optimisation.** Design and optimise a broad range of products, processes and systems, based on key technical and sustainability related factors.
A6	**Experimental design and delivery.** Plan, execute and communicate the outputs of an experiment (or project).
A7	**Experimental approaches.** Use and integrate a wide range of computational and experimental approaches to solve biomedical engineering problems
A8	**Engineering economics.** Understand economic evaluation and business principles relevant to biomedical engineering.
A9	**Engineering responsibility.** Understand the roles and responsibility of biomedical engineers in society and their impact on both a local and global context.

Graduate Attributes

R1	Adapt to changes in the face of adversity and an appreciation of how this feeds into life long learning
R2	Identify and appreciate the skills for personal and professional self-development.
R3	Persevere and sustain interest in long-term goals.
Cr1	Evaluate complex or contradictory information, data and processes in order to make judgements and decisions.

Cr2	Identify and solve real world problems, developing creative solutions with a full awareness of sustainability.
Cr3	Apply creativity in product and systems design, incorporating different disciplinary and cultural perspectives.
Cr4	Evaluate, model and improve a range of multicomponent systems.
Co1	Be effective in verbal communication, develop speaking and listening skills, and provide and receive constructive feedback.
Co2	Convey complex technical, professional and other information in written form to suit a range of audiences.
Co3	Use a range of digital technologies to facilitate effective verbal, graphical and visual communication of technical ideas with engineers, scientists, technicians and a lay audience
Co4	Work effectively in a team, appreciating different team roles including the leadership.
P1	Use project management tools and develop skills to deliver projects in industry, research and elsewhere.
P2	Understand and comply with professional engineering and scientific ethics and codes of conduct.
P3	Understand the importance of health and safety (H&S) from personal, professional and corporate responsibility viewpoints.
P4	Have a working knowledge of intellectual property (IP) considerations and other commercial aspects of product development
P5	Have a working knowledge and ability to comply with relevant regulatory frameworks, quality assurance processes and good laboratory practice.
T1	evaluate and select the appropriate prototyping and manufacturing techniques
T2	Plan, use and record data from laboratory and workshop techniques pertinent to the discipline of study.
T3	Evaluate risk and uncertainty using appropriate statistical methods applied to engineering and scientific problems and other evaluation methods.
T4	Design tests and experiments to fabricate or synthesise different engineering systems, components or materials, and to measure or monitor their performance or properties.
T5	Critically analyse engineering/scientific problems at quantitative and qualitative levels
T6	Use computer programming to model and solve science and engineering problems.
T7	Use common software tools for engineering design & analysis

3 Learning and teaching approaches

Teaching methods are tailor-made to suit the size of classes and the nature of the subject. Each module has a combination of methods including lectures, tutorials, laboratory sessions, industrial visits, workshops and group work. The University's degrees combine face to face teaching and practical experiences with supported and structured on-line learning. Our virtual learning platform is referred to as QMplus. Through this platform you will be able to find details about your modules, assessments, timetables and other activities. Projects throughout the programme are designed for you to exercise independent thinking, research and problem solving skills. Group work enhances your communication, organisational as well as technical skills.

3.1 Employers Links

The school has an active Industrial Liaison forum (ILF). This forum has a direct impact on the programmes by encouraging employers to sponsor and support the students and to provide real design case studies to engage the students throughout the curriculum. Recent case studies and industrial support have been delivered by a range of companies including DePuys, Baxter, Kuros Biosciences AG, NuVasive, Emulate, Calla Lily Clinical Care, Blatchford Group. The ILF takes place twice a year, in Autumn and Spring.

3.2 Assessment methods

You can expect a variety of different types of assessment methods:

Written assessment
- Examinations
- Progress tests
- Online assignments and quizzes
- Report and other writing
- Peer assessment

Practical assessment
- Laboratory/workshop practicals
- Design work
- Programming tests
- CAD & simulation tool tests

Oral assessment
- Oral presentations
- Poster presentations
- Group presentations
- Design presentations

Assessments allow you to demonstrate that you have met the intended learning outcomes for each module and contribute towards your achievement of the programme learning outcomes. There are summative (formal) assessments during and/or at the end of each module and well as ongoing formative (informal – no marks) through the degree. Examinations are intended to assess understanding rather than recall. Group assessments may incorporate peer marking.

Assessments operate in accordance with The University's Regulations and established procedures. Feedback is provided through a number of formats, including:

- Oral e.g. face to face during or after face-to-face sessions, video
- Personal e.g. discussion with staff
- Interactive e.g. Team Based Learning, peer-to-peer, online quizzes
- Written e.g. solutions, model answers, comments on work

You will receive feedback on intermediate, developmental assessments such as project plan and progress reports and on coursework assessments. This feedback may be summarised for

the whole cohort or be directed towards your work individually.

The final project thesis will be assessed in September and the student will also complete a presentation as well as an oral examination.

Feedback is intended to help you learn and you are encouraged to engage with it, reflect upon it and discuss it with your module organiser. Feedback will be provided on coursework and practical assessments within an appropriate time. Feedback on examination performance is available upon request from the module leader and overall class performance feedback on a question-by-question basis may also be provided.

3.3 Support of students

We aim to support all students throughout their time with us. We encourage students to develop independently but this does not mean that you need to be alone. We know that support and encouragement from staff and fellow students is very important throughout your degree.

The Student Support Officer for SEMS is the first contact for any personal support; they can be contacted by email: sems-office@qmul.ac.uk with any questions or to arrange an appointment.

3.3.1 Advisor arrangements

You will be allocated an Advisor when you register. You will meet with your Advisor at least twice per semester, but can always book more meetings if you need help.

3.3.2 Central support services Disability and Dyslexia Service

The University 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 students.

Advice and Counselling

The University offers a wide range of advice, guidance and self-help material. These free and confidential professional services are available to all students.

4 Programme structure

45 credits of taught modules will be taught in the first semester from September until December plus an additional 15 credits of taught material associated with the research project. A further 45 credits of taught modules will be taught in the second semester from January until April. All taught module examinations will be in the standard examination periods during January and May. The 90 credit Extended Research Project will be completed over 3 semesters.

The modules making up the programme are presented in the table below. The indicative study programme in 4 pathways, namely Clinical Engineering, Biomechanics, Artificial Intelligence and Digital Healthcare, Biomaterials in Biomedical Engineering is as follows, depending on the student's background and interests. All students will study:

Module	Semester	Title		Credit
EMS715P	A,B,C	Extended Research Project	Core	90
EMS719P	B	Medical Ethics and Regulatory Affairs	Compulsory	15

Students will select **one** of the following pathways

Pathway A *Clinical Engineering*

Module	Semester	Title		Credit
EMS762P	A	Clinical Bioengineering: Applications in Urology	Compulsory	15
EMS706P	A	Clinical Sensors & Measurements	Compulsory	15
1 from:				
EMS740P	A	Machine Learning and Artificial Intelligence for Engineering	Elective	15
EMS738P	A	Interpretation and Analysis in Biomedical Imaging *	Elective	15
EMS718P	A	Nanotechnology and Nanomedicine	Elective	15
EMS701P	B	Medical Robotics & Surgical Techniques	Compulsory	15
1 from:				
EMS732P	B	Digital Manufacture for Healthcare Innovations	Elective	15
EMS741P	B	Deep Learning for Data and Image Analysis	Elective	15
EMS707P	B	Digital Signal Acquisition & Processing	Elective	15
EMS735P	B	Biocompatibility Evaluation for Clinical Innovation*	Elective	15

Pathway B *Biomechanics*

Module	Semester	Title		Credit
EMS762P	A	Clinical Bioengineering: Applications in Urology	Compulsory	15
EMS724P	A	Computational Engineering	Compulsory	15
1 from:				
EMS706P	A	Clinical Sensors & Measurements	Elective	15
EMS740P	A	Machine Learning and Artificial Intelligence for Engineering	Elective	15
EMS709P	B	Computational Fluid Dynamics	Compulsory	15
1 from:				
EMS732P	B	Digital Manufacture for Healthcare Innovations	Elective	15
EMS701P	B	Medical Robotics & Surgical Techniques	Elective	15
EMS737P	B	Experimentation and Modelling in Cell and Tissue Biomechanics*	Elective	15

Pathway C *Artificial Intelligence and Digital Healthcare*

Module	Semester	Title		Credit
EMS726P	A	Engineering Design Optimisation & Decision Making	Compulsory	15
EMS740P	A	Machine Learning and Artificial Intelligence for Engineering	Compulsory	15

1 from:				
EMS738P	A	Interpretation and Analysis in Biomedical Imaging *	Elective	15
EMS714P	A	Modern Robotics: Fundamentals and Applications	Elective	15
EMS741P	B	Deep Learning for Data and Image Analysis	Compulsory	15
1 from:				
EMS707P	B	Digital Signal Acquisition & Processing	Elective	15
EMS701P	B	Medical Robotics & Surgical Techniques	Elective	15
EMS729P	B	Cognitive Robotics	Elective	15

Pathway D *Biomaterials*

Module	Semester	Title		Credit
EMS718P	A	Nanotechnology and Nanomedicine	Compulsory	15
EMS712P	A	Macromolecular Engineering	Compulsory	15
EMS706P	A	Clinical Sensors & Measurements	Compulsory	15
EMS732P	B	Digital Manufacture for Healthcare Innovations	Compulsory	15
1 from:				
EMS736P	B	Clinical Applications in Regenerative Medicine*	Elective	15
EMS737P	B	Experimentation and Modelling in Cell and Tissue Biomechanics*	Elective	15
EMS735P	B	Biocompatibility Evaluation for Clinical Innovation*	Elective	15
EMS730P	B	Advanced Nanocomposites	Elective	15

* Students **may not** select: Interpretation and Analysis in Biomedical Imaging, Clinical applications in regenerative medicine; Biocompatibility Evaluation for Clinical Innovation, or Experimentation and Modelling in Cell and Tissue Biomechanics, if they have previously studied at undergraduate level EMS620U, EMS617U, EMS615U, or EMS618U respectively.

5 Entry requirements

Students will be admitted according to the entry requirements found at:

https://www.sems.qmul.ac.uk/pgadmissions/

6 Quality assurance

6.1 Student Voice Committee (SVC) meetings

The School has a Student Voice Committee and students on this programme are represented on this committee. The committee meets twice during each semester and is made up of the following members:

- Academic Lead for Student Experience (Chair)
- Student Support Officer (Secretary)
- Directors of the relevant programmes
- At least one student representing the relevant programmes

The elections for the postgraduate representatives are organised through the Student Union. SVC agendas and minutes are found on the SEMS QMplus landing page. Relevant items on the minutes are referred to the appropriate School committees for consideration and feedback.

6.2 Evaluating and improving the quality and standards of teaching and learning

We assess our provision of teaching by:

- Module review by means of student experiance questionnaires and module organisers' reports.
- Annual staff appraisal.
- Peer observation of teaching.
- External examiners' reports.
- Periodic Programme Review by the University.

The Committees within SEMS that have responsibility for monitoring and evaluating quality and standards are

- Education Committee
- Student Experience Committee
- Academic Standards Committee
- Student Voice Committee
- Subject Examination Boards
- Degree Examination Boards

The ways we receive student feedback on the quality of teaching and your learning experience are:

- Annual Postgraduate Taught Experience Survey (PTES)
- Student Voice Committee
- Student Questionnaire evaluation for each of your modules
- Student forums on QMplus, including module and programme specific forums as well as ones covering more general topics
- Discussions with Advisors.

6.3 Staff development

Our staff are continuously engaging with professional development activities, including courses and workshops related to teaching and learning.