Programme Title: MEng Biomedical Engineering, MEng Biomedical Engineering with Industrial Experience

Programme Specification

Awarding Body/Institution	Queen Mary University of London
Teaching Institution	Queen Mary University of London
Name of Final Award and Programme Title	MEng (Hons) Biomedical Engineering/MEng (Hons) Biomedical Engineering with Industrial Experience
Name of Interim Award(s)	
Duration of Study / Period of Registration	4/5 years
QM Programme Code / UCAS Code(s)	HBF5/HBF3
QAA Benchmark Group	Engineering
FHEQ Level of Award	Level 7
Programme Accredited by	Institute of Mechanical Engineers Nov17
Date Programme Specification Approved	2 Jan 2017
Responsible School / Institute	School of Engineering & Materials Science

Schools which will also be involved in teaching part of the programme
Centre for Commercial Law Studies

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

Programme Outline

The MEng degree in Biomedical Engineering is an advanced 4 year integrated master programme, part of suite of programmes offered in Biomedical Engineering at Queen Mary. Biomedical Engineering is the diverse and exciting subject that covers the science and engineering responsible for many of the latest advances in medicine. It encompasses the design and development of artificial medical implants such as hip joints, heart valves and prosthetic limbs, as well as the development of wide ranging medical technologies including surgical robots, nanomedicine, tissue engineering, diagnostic tools and rehabilitation equipment. Another branch of Biomedical Engineering focuses on the physics and chemistry of how our bodies function and the biomaterials from which we are made. This might involve understanding the mechanical properties of living cells, or measuring the forces and movements of a patient walking. In all these areas, Biomedical Engineers are pushing forward the frontiers of medicine, developing new ways to diagnose and treat medical problems, diseases and injuries.

The suite of Biomedical Engineering programmes at QMUL is one of the largest in the country, with a particularly extensive number of specialist academic staff. Key specialities in Biomedical Engineering at QMUL are as follows:
- Tissue Engineering and Regenerative Medicine
- Orthopaedic Implants
- Biomechanics and Mechanobiology: from whole patients to single cells

- Diagnostic Systems and Instrumentation
- Biofluids (Experimental and Computational)
- Biomaterials

The first two years of the Biomedical Engineering programme provides a firm grounding in subjects fundamental to all branches of Engineering, including Design, Fluid Mechanics, Solid Mechanics and Dynamics. They also provide an insight into computing and training in workshop practice. Alongside this fundamental engineering training, students learn the basic biology, chemistry and medicine required to work in the biomedical engineering field, and additionally are introduced to concepts of working at the engineering and medicine interface.

The third year gives you the opportunity to specialise in some areas of Biomedical Engineering of particular interest to you. It also includes an individual project, which may be an experimental research project, a theoretical investigation, a detailed design study, or a critical review of a topic in Biomedical Engineering of mutual interest to yourself and your supervisor.

In the fourth year students undertake further specialised modules as well as a group design project, which emphasises the benefits of teamwork and is often linked to industry. The project is an excellent opportunity to consolidate learning from previous years, with a focus of solving a real industrial biomedical engineering problem. Students learn to function effectively as a team, allocating work and responsibilities appropriately, as well as developing an industrial link and gaining experience to add to their CV. Where possible projects are multi-disciplinary, with groups including students from other Engineering streams such as Mechanical Engineering or Materials Science. They also develop many transferable skills and will have the responsibility for the overall management of the project including its finances.

The Biomedical Engineering MEng (Hons) programme is accredited by the Institution of Mechanical Engineers (IMechE), and fully meets the exemplifying academic benchmarks requirements, for registration as a Chartered Engineer (CEng). Enrolment as a student member of the IMechE is encouraged.

Aims of the Programme

The aim of the Biomedical Engineering MEng degree programme at QMUL is to provide students with the fundamental training needed to become a professional engineer along with the specialist expertise in Biomedical Engineering needed to take advantage of career opportunities in medicine and the healthcare industries. The programme gives students the ability to develop and adapt to new technologies and meet the needs of industry, by being aware of the professional and ethical responsibilities of engineers. This degree subsequently provides an attractive option for students interested in the broad area of Biomedical Engineering or for those seeking an alternative to medicine.
It will produce graduates:
- with sufficient technical knowledge to undertake roles as leading engineers across the engineering sector
- who are sufficiently proficient in medical terminology to converse with clinical and surgical staff
- with the personal and interpersonal skills to work closely and communicate effectively with colleagues in a work environment
- with sufficient management and design knowledge to successfully integrate into, or manage, engineering projects
- With both a broad and in-depth knowledge and understanding of Biomedical Engineering
- Able to manage, undertake and effectively steer significant group research projects
- To understand and respond to industrials lead

What Will You Be Expected to Achieve?

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

Academic Content:	
A 1	Knowledge of the scientific and engineering principles necessary to underpin their education in Engineering, with particular reference to Biomedical Engineering.
A 2	Understanding of mathematical principles underpinning Engineering, particularly Biomedical Engineering, in addition to the mathematical methods, tools and notations used in the analysis of Biomedical Engineering problems.

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A 3	An understanding of concepts from a range of areas, particularly those related to medicine, and the ability to apply them effectively in Engineering projects.
A 4	An awareness of existing and developing technologies related to Biomedical Engineering.
A 5	An understanding of how engineers and clinicians interface within the medical sector and the technological requirements of the medical sector.
A 6	Knowledge of the ethical issues underpinning the Biomedical Engineering profession and how a medical engineer must operate within these.
A 7	Knowledge of the regulatory framework governing the development of new Biomedical Engineering products.
A 8	Comprehensive and practical knowledge of the design process and project management
A 9	Understanding of, and ability to utilise, relevant Business and Management principles

Disciplinary Skills - able to:	
B 1	Understand engineering principles and apply them to analyse key Biomedical Engineering problems.
B 2	Extract data pertinent to an unfamiliar problem, and apply it, particularly in relation to the medical field.
B 3	Apply quantitative methods and computer software relevant to engineering disciplines, to solve Biomedical Engineering problems.
B 4	Use fundamental knowledge to investigate new and emerging medical related technologies.
B 5	Use appropriate technical and non-technical language to effectively communicate and interface with clinicians to formulate an engineering solution to a medical problem.
B 6	Learn new theories, concepts and methods, and apply them 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	Utilise team working and project management skills to effectively work with colleagues on biomedical engineering projects
B 11	Proficiency in analytical and computational technologies towards the design or analysis of biomedical engineering devices or systems, or solving problems relevant to medical engineering
B 12	Exercise professional judgement in biomedical engineering related problems solving, considering ethical and economic issues
B 13	Apply initiative and creativity to the design development and analysis of biomedical engineering devices or solutions.
B 14	Use and integrate both computational and experimental approaches to address engineering problems

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Attributes:	
C 1	Engage critically with knowledge, and apply it in a rigourous way
C 2	Use communication approaches competently to engage with a range of audiences
C 3	Critically evaluate the reliability of different sources of information
C 4	Use information for evidence based decision making
C 5	Generate, analyse and interpret quantitative data confidently and competently
C 6	Develop the necessary transferable skills to be an effective leader in the workplace
C 7	Develop awareness of Health and Safety
C 8	Improve their appreciation of values of Biomedical Engineering in society and ethical framework

QMUL Model Learning Outcomes - Level 4:	
D 1	Identify and discuss their own career aspirations or enterprise skills and knowledge and how they impact on others
D 2	Identify and discuss what their own role in their programme and/or subject discipline might mean to them for future e
D 3	Identify and demonstrate the perspectives or problem solving techniques of different disciplines
D 4	Demonstrate connections between different theoretical perspectives within your discipline

How Will You Learn?

Teaching materials are delivered through a combination of lectures, problem solving classes, laboratory practicals, and a variety of coursework. In addition problem-based learning plays a role in the your first and second years.

You will undertake a major individual research project in the third year, and a substantive industrially led group research project in the fourth year, both of which are designed to assimilate and utilise knowledge gained throughout the degree towards approaching a real Engineering problem.

The 3rd year project allows you to participate in the specialist internationally-recognised research taking place within the School of Engineering and Materials Science. The 4th year project is a group design project worth half of the final year. These exciting student-led projects are frequently sponsored by industry and provide a valuable insight into real life engineering design and project management.

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. Some modules, such as the research and design projects, count for two or four modules. In the third and fourth year, you can select from a range of module options allowing you to tailor your degree to specific areas of interest within your specialist degree programme.

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How is the Programme Structured?

Please specify the full time and part time programme diets (if appropriate).

The Biomedical Engineering MEng programme at QMUL is an integrated 4 year programme. The first three years of the MEng follow the format of the BEng degree programme, with the 4th year providing additional opportunity to specialise, alongside the experience of industrially related group project work.

Whilst at University, you gain a solid foundation in Engineering by studying core Engineering modules such as Mathematics, Solid Mechanics, Design, Dynamics and Fluid Mechanics. In addition, you take specialist Biomedical Engineering modules starting in year 1 and these increase in number throughout the degree programme. In years 3 and 4, you are able to choose your modules from a broad range of Biomedical Engineering module options (see programme structure below). This allows you to tailor your degree programme to match your own Biomedical Engineering interests and career intentions.

We also offer the MEng degree 'with Industrial Experience' where you would take a year working in a Biomedical Engineering related industrial position between your third and fourth years of study. You are paid by the company during this year which also counts towards their degree. If you are not registered on a 'with Industrial Experience' programme you can opt into it at any stage prior to taking your placement. You would extend your studies by a year as you undertake a structured programme at one of our many partner companies. To support this activity we employ a full time Industrial Placement Manager in the School, who supports you through the application process and then manages the programme whilst you are on the placement. Recent placement employers include: DSTL, RollsRoyce, DePuy, Aloca, Microsoft, ARTIS, GE, Caterham F1 & Philips. This exciting opportunity gives you a valuable insight into future careers and enhances employability.

QMUL Model

Students are required to undertake the equivalent of one module (15 credits in 2017/18) per year of study which has been identified as meeting the requirements of the QMUL Model. Each of these modules has been designed to combine the best of QMUL's academic excellence with your ability to identify and develop your skills, networks and experience. This will help to ensure you become a graduate who can undertake further study or secure graduate employment in areas that interest you, and will support your ability to position yourself to find the right job or opportunity for you. The relevant module for your first year of study in 2017/18 is indicated below.

Where more than one module is specified, this is because pertinent elements from these modules have been identified as being appropriate to the QMUL Model and when studied together, deliver the equivalent content of one 15-credit QMUL Model module.

The QMUL Model modules for future years and associated Learning Outcomes will be identified as your studies continue.

Should Professional, Statutory and Regulatory Body requirements apply to your programme of study, these will be taken into account in the specification of QMUL Model requirements.

Academic Year of Study FT - Year 1

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Module Title	Module Code	Credits	Level	Module Selection Status	Academic Year of Study	Semester	QMUL Model
Engineering Design Methods	MAT4002	15	4	Compulsory	1	Semester 1	Yes
Mechanics of Fluids I	DEN4101	15	4	Compulsory	1	Semester 1	Yes
Mathematics and Computing for Engineers 1	DEN4122	15	4	Compulsory	1	Semester 1	No
Clinical Problems in Biomedical Engineering and Materials	MAT4003	15	4	Compulsory	1	Semester 1	No
Mathematics and Computing for Engineers 2	DEN4123	15	4	Compulsory	1	Semester 2	No
Engineering Mechanics: Statics	DEN4102	15	4	Compulsory	1	Semester 2	No
Engineering Mechanics: Dynamics	DEN4108	15	4	Compulsory	1	Semester 2	No
Clinical Solutions in Biomedical Engineering and Materials	MAT4004	15	4	Compulsory	1	Semester 2	No
Transferable Skills for Engineers and Materials Scientists	MAT4444	0	4	Compulsory	1	Semesters 1 & 2	No

Academic Year of Study FT - Year 2

Module Title	Module Code	Credits	Level	Module Selection Status	Academic Year of Study	Semester	QMUL Model
Design for Manufacture	DEN5101	15	5	Compulsory	2	Semester 1	No
Grad, div and curl: Vector Calculus for Engineering	DEN5122	15	5	Compulsory	2	Semester 1	No
Engineering Instrumentation	DEN5109	15	5	Compulsory	2	Semester 1	No
Neuromuscular Bioelectricity and Biomechanics	DEN5302	15	5	Compulsory	2	Semester 1	No
Engineering Materials for Design	DEN5002	15	5	Compulsory	2	Semester 2	No
Solid Mechanics	DEN5102	15	5	Compulsory	2	Semester 2	No

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Module Title	Module Code	Credits	Level	Module Selection Status	Academic Year of Study	Semester	QMUL Model
Control Systems Analysis and Design	DEN5200	15	5	Compulsory	2	Semester 2	No
Fluid Mechanics of the Cardiovascular System	DEN5300	15	5	Compulsory	2	Semester 2	No

Academic Year of Study FT - Year 3

Module Title	Module Code	Credits	Level	Module Selection Status	Academic Year of Study	Semester	QMUL Model
Individual Project	DEN318	30	6	Core	3	Semesters 1 & 2	No
Computer Aided Engineering for Solids and Fluids	DEN331	15	6	Compulsory	3	Semester 1	No
Tissue Engineering and Regenerative Medicine	MAT311	15	6	Compulsory	3	Semester 1	No
Materials Selection in Design	MAT602	15	6	Compulsory	3	Semester 1	No
Implant Design	DEN6437	15	6	Compulsory	3	Semester 2	No
Tissue Mechanics	DEN6311	15	6	Elective	3	Semester 2	No
Principles and Application of Medical Imaging	DEN324	15	6	Elective	3	Semester 2	No
Robotics	DEN408	15	7	Elective	3	Semester 2	No

Academic Year of Study FT - Year 4

Module Title	Module Code	Credits	Level	Module Selection Status	Academic Year of Study	Semester	QMUL Model
Research and Design Team Project	MAT7400	60	7	Core	4	Semesters 1 & 2	No
Computational Engineering	DEN401	15	7	Elective	4	Semester 1	No

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Module Title	Module Code	Credits	Level	Module Selection Status	Academic Year of Study	Semester	QMUL Model
Introduction to Law for Science and Engineering	IPLM701U	15	7	Elective	4	Semester 1	No
Bioengineering in Urology	DEN430	15	7	Elective	4	Semester 1	No
Surgical Techniques and Safety	DEN412	15	7	Elective	4	Semester 1	No
Computational Fluid Dynamics	DEN403	15	7	Elective	4	Semester 2	No
Clinical Measurements	DEN406	15	7	Elective	4	Semester 2	No
Foundations of Intellectual Property Law and Management	IPLM702U	15	7	Elective	4	Semester 2	No
Ethics and Regulatory Affairs	DEN7020	15	7	Elective	4	Semester 2	No
Principles and Applications of Bioelectricity	DEN7302	15	7	Elective	4	Semester 2	No
Advanced Biomaterials	MAT7071	15	7	Elective	4	Semester 2	No
Industrial Robotics and Mechatronics		15	7	Elective	4	Semester 2	No

What Are the Entry Requirements?

Minimum Entry Requirements with A-levels are:
AAA or 360 points from 3
Must include maths A-level and at least one science A-level (physics, biology, or chemistry).
Maths A-level must be an A or above

Other qualifications:
International Baccalaureate - 36 points or above overall, with maths and a science (physics, chemistry or biology) at higher level 6
European Baccalaureate - 85% or above including maths and science
French Baccalaureate - 15/20 overall, with 15/20 in maths and science
HE Advanced Diploma - Grade A or above overall, with Maths A-level grade A or above

How Do We Listen and Act on Your Feedback?

The Staff-Student Liaison Committee provides a formal means of communication and discussion between the School and its students. The committee consists of student representatives from each year of the programme, together with appropriate representation from staff within the School. 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 throughout 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 National Student Survey (NSS), 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 Personal Tutor, with further guidance available from the Senior Tutor and Programme Director, the latter having 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 MEng programmes. Students on the "with Industrial Experience" version need a year 1 average of at least 55% to progress to year 2 of the programme. Failure to achieve this will result in a transfer to the version without Industrial Experience.

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)
• 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 we co-deliver our training in study skills and career development for maximum benefit.
Since 2011 we have had a placement officer working in the school dedicated to supporting our new "with Industrial Experience" programmes which have grown immensely in popularity in the last few years.

The School 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 of our students in SEMS. Typically these events are attended by over 50 companies including our 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 our lecture programme in individual modules. Recent case studies that have been taught and assessed were delivered by companies including Tata, Gillette, Sugru, JRI, DuPuy, Apatech, Artis, BAe, DSTL, Rolls Royce, Perryman and Advanced Healthcare ltd.

Programme Specification Approval

Person completing Programme Specification	Dr Henri Huijberts
Person responsible for management of programme	Dr Helena Azevedo
Date Programme Specification produced/amended by School Learning and Teaching Committee	2 Jan 2017
Date Programme Specification approved by Taught Programmes Board	2 Jan 2017