Imperial College London

Programme Specification (Master's Level)

MSc Biomedical Engineering

This document provides a definitive record of the main features of the programme and the learning outcomes that a typical student may reasonably be expected to achieve and demonstrate if s/he takes full advantage of the learning opportunities provided. This programme specification is intended as a reference point for prospective students, current students, external examiners and academic and support staff involved in delivering the programme and enabling student development and achievement.

Programme Information				
Programme Title	Biomedical Engineering			
Award(s)	MSc			
Programme Code	B9A1			
Associateship	None			
Awarding Institution	Imperial College London			
Teaching Institution	Imperial College London			
Faculty	Faculty of Engineering			
Department	Department of Bioengineering			
Main Location of Study	South Kensington			
Mode and Period of Study	1 academic year (12 months), full-time			
Cohort Entry Points	Annually in October			
Relevant QAA Benchmark Statement(s) and/or other external reference points	Master's Awards in Engineering UK-SPEC			
Total Credits	ECTS:	90	CATS:	180
FHEQ Level	Level 7			
EHEA Level	2nd cycle			
External Accreditor(s)	Institute of Physics and Engineering in Medicine Institution of Mechanical Engineers Institute of Materials, Minerals & Mining			
Specification Details				
Student cohorts covered by specification	2018/19 entry			
Person responsible for the specification	Professor Martyn Boutelle			

Date of introduction of programme	October 1991
Date of programme specification/revision	July 2018

Description of Programme Contents

The MSc Biomedical Engineering programme provides students with technical knowledge, expertise and transferable skills in bioengineering. The programme is split into four streams to allow students to specialise in an area of interest.

All streams are modular, consisting of a core and options. The core material is largely common between the streams, but the options differ. Applicants may indicate their preferred stream(s) but applications will be assessed to ensure suitability of academic background for the preferred stream and not all applicants may be suitable for all streams. All four streams lead to the award of the MSc in Biomedical Engineering and can be studied on a full-time basis. The following streams are available:

Biomechanics
The Biomechanics stream is focused on bioengineering problems related to major diseases associated with an ageing population, such as cardiovascular disease, glaucoma and bone and joint disease. These are major causes of mortality and morbidity and this stream prepares engineers for a career in these key growth areas.

Biomaterials
The Biomaterials stream is offered jointly with the Department of Materials. It addresses the selection and use of biomaterials in medical and surgical devices, including their application, properties, interaction with tissues and drawbacks. Existing and new biomaterials are studied, including bioactive and biodegradable materials, implants and dental materials. Modules also cover the development of materials for new applications, the response of cells and the design of materials as scaffolds for tissue engineering, which involves tailoring materials so that they guide stem cells to produce new tissue.

Medical Physics
The Medical Physics stream trains students in the physical understanding required for healthcare and medical research, focusing on human physiology, and the use of radiation in treatment and in clinical imaging, as well as the signal and image processing methods needed for the design and optimal use of such systems in diagnosis and research.

Neurotechnology
The Neurotechnology stream covers the development of new technology for the investigation of brain function, focusing on the application of this to benefit society—for example the development of neuroprosthetic devices, new neuroimaging techniques, and developing drugs and robotic assistive devices for those with central nervous system disorders, as well as in biologically-inspired control engineering.

Learning Outcomes

Biomechanics
- Physiology of organs and cell function taught by lectures and problem classes
- Signal and image processing techniques taught by lectures and computer laboratory exercises
- Equipment and techniques to image the human body taught by lectures, group work and visits

- Equipment and techniques to acquire physiological and chemical information from the human body taught by lectures and laboratory classes

Biomaterials

- Various components of the human body, their function and the effects of ageing
- Vascular pathologies: arthrosclerosis, aneurysms
- The major classes of biomedical implant materials, their means of fixation, stability and the procedures and physiological principles involved in the replacement of various parts of the body with implants or tissue engineered constructs
- Advantages and disadvantages of current implants
- The reasons of failure of implants in various clinical applications
- The relative merits of replacing a body part with a tissue engineering construct
- Drug delivery devices
- How devices can be surface modified to improve function
- Characterisation of material: biomaterial-tissue and biomaterial-cell interfaces
- Challenges involved with transfer of laboratory inventions to a clinical product

Medical Physics

- Human physiology and cell function taught by lectures and problem classes
- Signal and image processing techniques taught by lectures and computer laboratory exercise
- Equipment and techniques to image the human body taught by lectures, group work and visits
- Equipment and techniques to acquire physiological and chemical information from the human body taught by lectures and laboratory classes
- Use of radiation in therapy and diagnosis taught by lectures

Neurotechnology

- Systems neuroscience, with particular emphasis on applications of technology to neuroscience, taught by lectures and problem classes
- Signal and image processing techniques taught by lectures and computer laboratory exercise
- Equipment and techniques to image the human body taught by lectures, group work and visits
- Equipment and techniques to acquire physiological and chemical information from the human body taught by lectures and laboratory classes

All streams

- Brainstorming for identifying hazards
- Critical review of scientific literature
- Ability to communicate alternative means to repair or replace parts of the body to both healthcare professionals and patients.
- Ability to perform original research by producing a dissertation
- Ability to perform data and statistical analysis
- Ability to present data

The Imperial Graduate Attributes are a set of core competencies which we expect students to achieve through completion of any Imperial College degree programme. The Graduate Attributes are available at: www.imperial.ac.uk/students/academic-support/graduate-attributes

Entry Requirements

Academic Requirement	Minimum 2.1 UK Honours degree (or equivalent) in a physical science, engineering or mathematical discipline. Although applicants will typically have a background in engineering or physical science, the course is potentially open to those from life sciences or medicine, provided they also have proven mathematics ability.
Non-academic Requirements	None
Applicants may be invited to attend an interview with one or more members of academic staff.	
English Language Requirement	IELTS 6.5 with a minimum of 6.0 in each element or equivalent.
The programme's competency standards document can be found at: http://www.imperial.ac.uk/media/imperial-college/faculty-of-engineering/bioengineering/public/student/Competency-Standards---Bioengineering-UG-PG---June-2016-Final.pdf	
Learning & Teaching Strategy	
Scheduled Learning & Teaching Methods	• Demonstrations • Group exercises • Guided practical classes • Individual research project • Laboratory work • Lectures • Presentations • Seminars • Workshops
E-learning & Blended Learning Methods	• Virtual Learning Environment using Blackboard • Lectures recorded using Panopto • YouTube videos • Anonymous feedback • Online groups/discussions • Online quizzes and interactive content
Project and Placement Learning Methods	• Group and individual project work
Assessment Strategy	
Assessment Methods	• Written examinations (open and closed book) • Oral presentations • Written reports, including a dissertation

	• Coursework including multiple choice progression tests, problem sheets, and quizzes

Academic Feedback Policy

Feedback will be provided on coursework within two weeks of submission. Feedback may be provided in one of a number of formats, including:

- Oral (during or after lectures)
- Personal (discussion with academics during office hours)
- Interactive (problem solving tutorials with GTAs & study groups)
- Written (solutions/model answers to coursework)

In line with College policy, feedback will not be provided on written examinations.

Numerical results will be published after the meeting of the final Board of Examiners.

Re-sit Policy

Eligibility for resits is determined by the Examination Board in line with the College policy. The Department of Bioengineering does not normally offer resits in September. Students with marginal failure may be offered a supplementary qualifying test in place of a re-sit opportunity. The College's Policy on Re-sits is available at: www.imperial.ac.uk/registry/exams/resit

Mitigating Circumstances Policy

The College's Policy on Mitigating Circumstances is available at: www.imperial.ac.uk/registry/exams

Assessment Structure

Rules of Progression and Classification

Pass
A student must:

- Achieve an aggregate mark of at least 50% in each module.
- Achieve a mark of at least 50% in the individual project
- Achieve an aggregate mark of at least 50% for the programme as a whole
- A student may be condoned in modules up to the value of 15 ECTS with a qualifying mark of at least 40%.

Merit
A student must:

- Achieve an aggregate mark of at least 50% in each module.
- Achieve a mark of at least 60% in the individual project
- Achieve an aggregate mark of at least 60% for the programme as a whole
- A student may be condoned in modules up to the value of 15 ECTS with a qualifying mark of at least 40%.

Distinction
A student must:

- Achieve an aggregate mark of at least 50% in each module.
- Achieve a mark of at least 70% in the individual project
- Achieve an aggregate mark of at least 70% for the programme as a whole
- A student may be condoned in modules up to the value of 15 ECTS with a qualifying mark of at least 40%.

Module		Weighting
Biomedical Imaging		5.6%
Journal Club		5.6%
Medical Device Certification		5.6%
Systems Physiology		5.6%
Statistics and Data Analysis		5.6%
Individual Project		44.4%
Biomechanics Pathway	Biomechanics	5.6%
	Physiological Fluid Mechanics	5.6%
	Molecular Cellular and Tissue Biomechanics	5.6%
	Orthopaedic Biomechanics	5.6%
	One module from elective group (A)	*5.6% each*
Biomaterials Pathway	Biomaterials	5.6%
	Advanced Biomaterials	5.6%
	Advanced Tissue Engineering	5.6%
	Tissue Engineering and Regenerative Medicine	5.6%
	One module from elective group (B)	*5.6% each*
Medical Physics Pathway	Advanced Physiological Monitoring and Data Analysis	5.6%
	Image Processing	5.6%
	Molecular and Tissue Imaging	5.6%
	Flow Imaging	5.6%
	One module from elective (C)	*5.6% each*

Neurotechnology Pathway	Neuroscience	5.6%
	Mathematical methods for Bioengineers	5.6%
	Brain Machine Interfaces	5.6%
	Two modules from elective group (D)	*5.6% each*

Indicative Module List											
Code	Title	Core/ Elective	L&T Hours	Ind. Study Hours	Place-ment Hours	Total Hours	% Written Exam	% Course-work	% Practical	FHEQ Level	ECTS
BE9-MBIMG	Biomedical Imaging	Core	28	97	0	125	100%	0%	0%	7	5
BE9-MJCLUB	Journal Club	Core	10	115	0	125	0%	0%	100%	7	5
BE9-MMDC	Medical Device Certification	Core	22	103	0	125	0%	100%	0%	7	5
BE9-MSPHYS	Systems Physiology	Core	30	95	0	125	100%	0%	0%	7	5
BE9-MSTDA	Statistics and Data Analysis	Core	28	97	0	125	100%	0%	0%	7	5
BE9-MMIP	Individual Project	Core	50	825	0	875	0%	90%	10%	7	35
BE3-HPFM	Physiological Fluid Mechanics	Variable	30	95	0	125	70%	30%	0%	6	5
BE9-MMCTB	Molecular Cellular and Tissue Biomechanics	Variable	27	98	0	125	80%	20%	0%	7	5
BE9-MOBMX	Orthopaedic Biomechanics	Variable	27	98	0	125	60%	30%	10%	7	5
MSE315	Biomaterials	Variable	*24*	*126*	*0*	*150*	*100%*	*0%*	*0%*	*7*	*6*
MSE417	Advanced Biomaterials	Variable	*24*	*126*	*0*	*150*	*100%*	*0%*	*0%*	*7*	*6*
MSE418	Advanced Tissue Engineering	Variable	*24*	*126*	*0*	*150*	*100%*	*0%*	*0%*	*7*	*6*
BE3-HTERM	Tissue Engineering and Regenerative Medicine	Variable	28	97	0	125	100%	0%	0%	7	5

Indicative Module List											
Code	Title	Core/ Elective	L&T Hours	Ind. Study Hours	Place-ment Hours	Total Hours	% Written Exam	% Course-work	% Practical	FHEQ Level	ECTS
BE9-MAPMDA	Advanced Physiological Monitoring and Data Analysis	Variable	26	99	0	125	100%	0%	0%	7	5
BE3-HIPR	Image Processing	Variable	38	87	0	125	100%	0%	0%	6	5
BE9-MBMI	Brain Machine Interfaces	Variable	30	95	0	125	80%	20%	0%	7	5
BE9-MFIMG	Flow Imaging	Variable	224	101	0	125	100%	0%	0%	7	5
BE9-MCMM	Cellular and Molecular Mechanotransduction	Elective (A)	20	105	0	125	100%	0%	0%	7	5
BE3-HBACSA	Biomedical Advanced Computational and Stress Analysis	Elective (A)	24	101	0	125	70%	30%	0%	6	5
BE9-MHNCL	Human Neuromechanical Control and Learning	Elective (A/D)	27	98	0	125	80%	20%	0%	7	5
BE9-MBMX	Biomechanics	Elective (B)	28	97	0	125	100%	0%	0%	7	5
BE9-MMTI	Molecular and Tissue Imaging	Elective (B)	27	98	0	125	100%	0%	0%	7	5
BE9-MMB	Mathematical Methods for Bioengineers	Elective (B/C)	27	98	0	125	40%	60%	0%	7	5
BE9-MBMIME	Biomimetics	Elective (B/D)	27	98	0	125	80%	0%	20%	7	5

Indicative Module List											
Code	Title	Core/ Elective	L&T Hours	Ind. Study Hours	Place-ment Hours	Total Hours	% Written Exam	% Course-work	% Practical	FHEQ Level	ECTS
BE9-MECT	Engineering in Cancer Therapy	Elective (C)	20	105	0	125	90%	10%	0%	7	5
BE9-MINS	Neuroscience	Elective (C)	30	95	0	125	100%	0%	0%	7	5
BE9-MCNS	Computational Neuroscience	Elective (D)	37	88	0	125	100%	0%	0%	7	5
BE9-MMLNC	Machine Learning and Neural Computation	Elective (D)	34	91	0	125	67%	33%	0%	7	5
BE9-MHASP	Hearing and Speech Processing	Elective (D)	27	98	0	125	100%	0%	0%	7	5

Supporting Information
The Programme Handbook is available at: http://www.imperial.ac.uk/bioengineering/admin/msc/
The Module Handbook is available at: http://www.imperial.ac.uk/bioengineering/admin/msc/
The College's entry requirements for postgraduate programmes can be found at: www.imperial.ac.uk/study/pg/apply/requirements
The College's Quality & Enhancement Framework is available at: www.imperial.ac.uk/registry/proceduresandregulations/qualityassurance
The College's Academic and Examination Regulations can be found at: http://www3.imperial.ac.uk/registry/proceduresandregulations/regulations
Imperial College is an independent corporation whose legal status derives from a Royal Charter granted under Letters Patent in 1907. In 2007 a Supplemental Charter and Statutes was granted by HM Queen Elizabeth II. This Supplemental Charter, which came into force on the date of the College's Centenary, 8th July 2007, established the College as a University with the name and style of "The Imperial College of Science, Technology and Medicine". http://www.imperial.ac.uk/admin-services/secretariat/college-governance/charters/charter-and-statutes/
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