

**MSc Human and Biological Robotics**

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 primarily intended as a reference point for academic and support staff involved in delivering the programme and enabling student development and achievement, for its assessment by internal and external examiners, and in subsequent monitoring and review.

**Programme Information**

Award(s)	MSc			
Programme Title	Human and Biological Robotics			
Programme code	BHM1			
Awarding Institution	Imperial College London			
Teaching Institution	Imperial College London			
Faculty	Faculty of Engineering			
Department	Department of Bioengineering			
Associateship	None			
Mode and Period of Study	1 calendar year full-time (12 months)			
Cohort Entry Points	Annually in October			
Relevant <a href="#">QAA Benchmark Statement(s)</a> and/or other external reference points	Master's awards in Engineering			
Total Credits	ECTS:	90	CATS:	180
<a href="#">FHEQ Level</a>	Level 7			
<a href="#">EHEA Level</a>	2 <sup>nd</sup> cycle			
External Accreditor(s)	None			
<b>Specification Details</b>				
Student cohorts covered by specification	2016-17 entry			
Person Responsible for the specification	Professor Martyn Boutelle			
Date of introduction of programme	October 2016			
Date of programme specification/revision	July 2016			

## Description of Programme Contents

The MSc Human and Biological Robotics programme arises from the Imperial Robotics Forum (<http://www.imperial.ac.uk/robotics>), which groups together robotics researchers at Imperial and forms one of the largest institutional robotics networks. Particular strengths of the forum include robotics for humans and society, including medical robotics, service and social robotics, rehabilitation technology, as well as related machine vision, artificial intelligence and machine learning. Research arising from the Robotics Forum is multi-disciplinary and at the cutting edge of several disciplines. The programme will allow students to work in a truly inter-departmental and cross-disciplinary environment, in a pioneering and rapidly growing sector.

This MSc builds upon the unique strengths of the Department of Bioengineering and Imperial in this new field. The programme will focus on the emerging research field of *Human and Biological Robotics - robotics of humans and animals, robotics for humans*, including:

- a. The use of tools and techniques from robotics to investigate the sensorimotor control in humans and animals;
- b. The development of robotics tools to assist humans, e.g. interfaces to working in hazardous environments or with physically or neurologically impaired individuals.

Students of the programme will be based in the Department of Bioengineering, at Imperial's South Kensington Campus. They will spend the majority of their time in Bioengineering but given the interdisciplinary nature of the programme and the contribution to teaching from several other Departments students will also spend time in other Departments. Indeed, it is expected that some students may complete their MSc Individual Projects either entirely or partially in a different Department to Bioengineering, as a result of the collaboration within the Robotics Forum. Members of the Robotics Forum, and their associated Departments, including Bioengineering, have strong industrial links. In Bioengineering these are cultivated and managed by the Industrial Liaison Manager. As such, there may be opportunities for students to work with industry throughout the programme, for example on their individual research projects.

## Learning Outcomes

### Knowledge and Understanding of:

- Neuromechanics modelling of sensory or motor functions in biological systems and in particular in humans, taught by lectures and problem classes.
- Biomimetics design and applications.
- Signal and image processing techniques taught by lectures and computer laboratory exercise.
- Robotics and its applications to assistive devices for everyday life
- Equipment and techniques to acquire physiological and chemical information from the human body taught by lectures and laboratory classes.

### Intellectual Skills:

- Brainstorming for identifying hazards (risk analysis exercise)

### Practical Skills:

- Ability to perform original research by producing a dissertation
- Ability to perform data and statistical analysis
- Ability to present data both orally and as part of a technical report
- Ability to consider biological and human factors in modelling and for biomimetic design

- Project management

Transferable skills:

- Problem solving with critical thinking and analytical skills.
- Communication of technical and non-technical information through a range of methods, to a variety of audiences.
- Teamwork, negotiation, leadership and advocacy skills.
- Ability to work independently, plan projects, and manage time and resources effectively.
- Ability to understand interdisciplinary concepts and apply them in innovative ways

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](http://www.imperial.ac.uk/students/academic-support/graduate-attributes)

**Entry Requirements**

Academic Requirement	An upper second class UK honours degree or equivalent in engineering, physical science or mathematics to include an element of mathematics.
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Additional Requirements	<p>Grade A in A level Mathematics or equivalent</p> <p>Applicants should have a knowledge and understanding of the following mathematics at undergraduate level:</p> <ul style="list-style-type: none"> <li>• Linear algebra in N dimensional spaces.</li> <li>• N-dimensional calculus.</li> <li>• Basic probability theory (including mean, variance, correlation, Gaussian distribution, binomial distribution, Bayes theorem).</li> <li>• Previous experience of programming and use of MatLab or similar software to solve engineering problems.</li> </ul>
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Students may be invited to attend an interview

English Language Requirement	IELTS 6.5 with a minimum of 6.0 in each element or equivalent
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The programme's competency standards document is available online 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	<ul style="list-style-type: none"> <li>• Lectures</li> <li>• Guided practical classes / laboratory work, and demonstrations</li> <li>• Seminars</li> </ul>
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	<ul style="list-style-type: none"> <li>• Workshops</li> <li>• Group exercises</li> <li>• Presentations</li> <li>• Individual research project</li> </ul>
E-learning & Blended Learning Methods	<ul style="list-style-type: none"> <li>• Virtual Learning Environment: Blackboard</li> <li>• Online groups/discussions</li> <li>• Online quizzes and interactive content</li> <li>• You tube videos</li> <li>• Anonymous feedback using Learning Catalytics, and Metimeter.</li> <li>• Lectures recorded using Panopto</li> </ul>
Project and Placement Learning Methods	<ul style="list-style-type: none"> <li>• Group and individual project work</li> </ul>
<b>Assessment Strategy</b>	
Assessment Methods	<ul style="list-style-type: none"> <li>• Written examinations (open and closed book)</li> <li>• Oral presentations</li> <li>• Written reports, including a dissertation</li> <li>• Coursework including multiple choice progression tests, problem sheets, and quizzes</li> </ul>
<b>Academic Feedback Policy</b>	
<p>Feedback will be provided on coursework within two weeks of submission. Feedback may be provided in one of a number of formats, including:</p> <ul style="list-style-type: none"> <li>• Oral (during or after lectures)</li> <li>• Personal (discussion with academics during office hours)</li> <li>• Interactive (problem solving tutorials with GTAs &amp; study groups)</li> <li>• Written (solutions/model answers to coursework)</li> </ul> <p>In line with College policy, feedback will not be provided on written examinations.</p> <p>Preliminary results will be provided to students as alpha-grades. Numerical results will be published after the meeting of the final Board of Examiners.</p>	
<b>Re-sit Policy</b>	
The College's Policy on Re-sits is available at: <a href="http://www.imperial.ac.uk/registry/exams/resit">www.imperial.ac.uk/registry/exams/resit</a>	
<b>Mitigating Circumstances Policy</b>	
The College's Policy on Mitigating Circumstances is available at: <a href="http://www.imperial.ac.uk/registry/exams">www.imperial.ac.uk/registry/exams</a>	
<b>Programme Structure</b>	
Full-time	Pre- Autumn Spring Summer Summer

	session	term	term	term	
Core Modules	0	4	1	0	0
Elective Modules	0	1-2	2-4	0	0
Projects	0	0	1		
Assessment Dates & Deadlines					
Written Examinations		January and May/June			
Coursework Assessments		Continuous			
Project Deadlines		Mid-September			
Practical Assessments		Continuous			
Assessment Structure					
Overall % weighting	Programme Component	Module	Module % Weighting		
30%	Core Modules	Systems Physiology	25%		
		Statistics and Data Analysis	25%		
		Medical Device Entrepreneurship	25%		
		Introduction to Robotics	25%		
30%	Elective Modules	<i>4 modules from elective group (A)</i>	20% each		
		<i>1 module from elective group (B)</i>	20%		
40%	Project	MSc Individual Project	100%		
Rules of Progression					
<p><b>Pass</b> A student must:</p> <ul style="list-style-type: none"> <li>Achieve an aggregate mark of at least 50% in each of the three programme components.</li> </ul> <p><b>Merit</b> A student must:</p> <ul style="list-style-type: none"> <li>Achieve an aggregate mark of at least 60% in each of the three programme components.</li> <li>At the discretion of the board of examiners achieve an aggregate mark of at least 60% in any two programme components and an aggregate mark of at least 50% in the remaining programme</li> </ul>					

component.

**Distinction**

A student must:

- Achieve an aggregate mark of at least 70% in each of the three programme components.
- At the discretion of the board of examiners achieve an aggregate mark of at least 70% in any two programme components and an aggregate mark of at least 60% in the remaining programme component.

Indicative Module List												
Code	Title	Core/ Elective	Year	L&T Hours	Ind. Study Hours	Place- ment Hours	Total Hours	% Written Exam	% Course- work	% Practical	FHEQ Level	ECTS
BE9-MSPHYS	Systems Physiology	Core	1	30	120	0	150	100%	0%	0%	7	6.00
BE9-MSTDA	Statistics and Data Analysis	Core	1	28	122	0	150	100%	0%	0%	7	6.00
BE9-MDEVEN	Medical Device Entrepreneurship	Core	1	27	123	0	150	0%	100%	0%	7	6.00
BE9-MMIP	MSc Individual Project	Core	1	42	858	0	900	0%	90%	10%	7	36.00
BE9-MITR	Introduction to Robotics	Core	1	30	120	0	150	80%	20%	0%	7	6.00
BE9-MHASP	Hearing and Speech Processing	Elective (A)	1	27	123	0	150	100%	0%	0%	7	6.00
BE9-MHNCL	Human Neuromechanical Control and Learning	Elective (A)	1	28	122	0	150	80%	20%	0%	7	6.00
BE9-MBMIME	Biomimetics	Elective (A)	1	26	124	0	150	100%	0%	0%	7	6.00
BE9-MMLNC	Machine Learning & Neural Computation	Elective (A)	1	30	120	0	150	80%	20%	0%	7	6.00
BE9-MCNS	Computational Neuroscience	Elective (A)	1	28	122	0	150	80%	20%	0%	7	6.00
BE9-MBMX	Biomechanics	Elective (A)	1	28	122	0	150	85%	15%	0%	7	6.00
BE3-HHCARD	H-CARD: Human Centred design of Assistive and Rehabilitation Devices	Elective (B)	1	28	122	0	150	80%	20%	0%	6	6.00
ME3-HECM	Embedded C for microcontrollers	Elective (B)	1	30	120	0	150	0%	100%	0%	6	6.00

**Indicative Module List**

Code	Title	Core/ Elective	Year	L&T Hours	Ind. Study Hours	Place- ment Hours	Total Hours	% Written Exam	% Course- work	% Practical	FHEQ Level	ECTS
CO333	Robotics	Elective (B)	1	27	123	0	150	85%	15%	0%	6	6.00



## Supporting Information

The Programme Handbook is available online at:  
<http://www.imperial.ac.uk/bioengineering/admin/msc/>

The Module Handbook is available online 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](http://www.imperial.ac.uk/study/pg/apply/requirements)

The College's Quality & Enhancement Framework is available at:  
[www.imperial.ac.uk/registry/proceduresandregulations/qualityassurance](http://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-statutes-ordinances-and-regulations/>

Imperial College London is regulated by the Higher Education Funding Council for England (HEFCE)  
<http://www.hefce.ac.uk/reg/of/>

## Modifications

Change to classification rules

Programmes  
Committee

25 October 2016

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