

Master of Science, Postgraduate Diploma, Postgraduate Certificate in Medical Engineering Design

Programme Specification Template: Postgraduate

Information for students: the programme specification is the definitive document summarising the structure and content of your degree programme. It is reviewed and updated every year as part of Keele’s Curriculum Annual Review and Development process. The document aims to clarify to potential and current students what you can expect from the study of the subject over the course of your programme.

Names of programme(s) and award title(s)	MSc/PgD/PgC Medical Engineering Design
Mode of study	Full time /Part Time
Framework of Higher Education Qualification (FHEQ) level of final award	7
Duration:	Full time Normally 12 months minimum Part time 24 months

Details of professional, statutory and regulatory body (PSRB) (If appropriate):

<http://www.keele.ac.uk/ga/professionalstatutoryregulatorybodies/>

External Examiner(s) names: <http://www.keele.ac.uk/ga/externalexaminers/>

1. What is the Philosophy of the Programme?

The aim of the programme is to enable students from non-engineering undergraduate degrees to undertake professional careers as *Medical Device Designers* in the healthcare industries. There is a recognised shortage of engineers across the UK as a whole¹. Furthermore, the Institution of Mechanical Engineers¹, for example, recognise a distinct bias towards the male population and are looking to schemes to address the shortfall by also addressing the gender imbalance. They have suggested that awards more directed towards engineering creativity (i.e. Engineering Design) may assist with both. This programme has been developed to meet these requirements but also of industry, as highlighted by HEFCE and the Engineering Council².

Engineering design can have a variety of impact points on medical practice, from the introduction of new devices to change in policy and practice. This MSc has been designed to allow students to specialise in the creative, problem solving engineering design discipline; but within the context of healthcare and clinical practice. Hence, producing designers who are both familiar with the clinical environment but who also understand its specific contextualisation. Keele is in an ideal position to deliver such an award based on its long-standing relationship with the NHS and its highly rated Research Institute, the Institute for Science and Technology in Medicine. Both have worked together to produce novel devices that are now in the market place; hence there is an opportunity to pass these skills on to the next generation of engineering designers allied to the healthcare profession.

¹ S Tatlow, IMechE – Keele visit, 23-2-2016

² Engineering Council, Engineering Professors Council. (2014). *Transition to Engineering*. (Accessed from <http://www.hefce.ac.uk/pubs/rereports/Year/2015/Engineering/Title,105476,en.html>)

For example, the NHS is becoming increasingly aware of energy management issues³: recent studies illustrate that they are the largest consumer of energy in the public sector (in 2009 circa 1/3 of the total CO₂ output from public buildings was from hospitals⁴). Even small changes in healthcare devices design and procedures can reduce this CO₂ burden, and not just changes in estate. Students graduating from this award will be able to provide solutions and be at the forefront of the drive to “effort reduction” within healthcare.

Engagement with our postgraduate programme will enable participants to further develop their intellectual, personal and professional capabilities. At Keele, we call these our ten Graduate Attributes and they include independent thinking, synthesizing information, creative problem solving, communicating clearly, and appreciating the social, environmental and global implications of their studies and activities. Whilst participants will undoubtedly have already developed these skills and abilities to varying degrees, such existing capabilities can always be deepened and enriched. Our educational programme and learning environment is designed to help participants to develop further as a well-rounded postgraduate who is capable of making a positive and valued contribution in a complex and rapidly changing world, whichever spheres of life they engage in during and after their studies at Keele.

The educational aims of the programme are designed primarily with student satisfaction at the forefront. Within this we endeavour to provide an environment where students are motivated to develop academically, personally, and professionally. Teaching is designed to provide a multidisciplinary perspective that encourages professional development beyond current specialities and growth into new areas. An area of particular importance to our course is training in the development of critical and evaluative thinking alongside refinement of writing and communication skills for application in individual research and team working scenarios. Through the development of these new and essential skill sets the student can expect to feel comfortable transferring scientific knowledge from theory into practise and to empower life-long learning.

The intended learning outcomes associated with the scheme cover two broad areas; Knowledge and Understanding, and Skills and Attributes.

Knowledge and Understanding.

At the culmination of the Masters programme students can expect to demonstrate:

- 1) an understanding of the core engineering principles within the context of engineering design practice,
- 2) an understanding of design methodologies and quality management issues,
- 3) modelling techniques commensurate with the role of a medical device designer,
- 4) an understanding of statistics and its role in research methods and design quality,
- 5) an understanding of the role of the engineer in society
- 6) knowledge of the generic, contextual principles supporting effective medical device design,
- 7) knowledge of associated environments and new technologies,
- 8) a critical awareness of technologies in their chosen pathway will develop towards the point where students will comfortably assist in the process of developing research projects, new devices and new solutions.

Taken together the student will have

- 9) developed the capacity to transfer scientific knowledge into practical application in medical devices design or their personal career choice.

Skills and Attributes.

After successful completion of the Masters programme the student can expect to demonstrate a broad range of newly gained Academic and Professional Skills. These will be

³ NHS, The NIHR Carbon Reduction Guidelines, October 2010

⁴ The Guardian, 2009, accessed from <http://image.guardian.co.uk/sys-files/Guardian/documents/2009/12/31/BuildingCO2.pdf>

- 10) an understanding of research process and evidence based practise,
- 11) a demonstrable ability to challenge, evaluate, modify, and develop the theory and practise surrounding engineering design,
- 12) the ability to synthesize and evaluate information obtained from diverse sources and settings,
- 13) the ability to identify personal and professional requirements in order to support lifelong learning, and
- 14) the ability to plan and manage projects.

In addition the MSc in Medical Engineering Design has been developed with the requirements of the Engineering Council UK-Spec as a “*matching section*” towards professional engineering qualifications for those with an accredited first degree in engineering.

2. How is the Programme taught?

Teaching is delivered primarily through seminars, group work, lectures and associated web-based Virtual Learning Environment materials. These are accompanied by tutor-led tutorials, laboratory-based practical sessions, seminars by nationally and internationally known scientists or engineers or clinicians, workshops, problem-solving scenarios, dedicated research project supervision and site-visits. Reflective of postgraduate education self-directed learning is also a major component during both full-time and part-time studies.

Evaluation of learning outcomes is met through a broad range of assessments. These include coursework-based essays, reports on laboratory-based practical experiments, written examinations, interactive oral presentations, and a dissertation based on the student research project.

The programme team consists of existing academic staff delivering on Masters Programmes in Biomedical Engineering, Cell and Tissue Engineering and Sustainability.

3. What is the Structure of the Programme?

The Medical Engineering Design Master’s programme is illustrated in Table 1. Students may opt to start in September intake or January intake with no detriment to their studies. Compulsory modules provide the backbone of engineering design and research principles that enable students to progress to an engineering design biased, industrially informed, dissertation. Specific underpinning knowledge is provided by the ability to select 2 option modules. This optional element structure allows students to tailor the learning experience towards individual requirements and strengths.

Award Paths

	Credits
Master of Science (MSc) Medical Engineering Design	180
Postgraduate Diploma (PgD) in Medical Engineering Design (Must include Engineering Design and Engineering Applications)	120
Postgraduate Certificate (PgC) in Medical Engineering Design (Must include either Engineering Design or Engineering Applications)	60

There are SEVEN compulsory modules making up 150 Credits in total.

The module “Engineering for Medical Applications” (Table 1) is a conversion module for students with no background in physical sciences. Students with a demonstrable first degree that contains the subject matter of this module may claim exemption, this should be discussed with the Programme Director on application or on enrolment, but this will need replacing with another option module.

A student can select up to 2 modules in order to make up the remaining 30 Credits and to “tailor” their MSc to their own aspirations and preferences. Students with no anatomy in previous studies are encouraged to

take Human Physiology and Anatomy as an option. The availability of these option modules is at the discretion of the University and the list can be modified as demand dictates.

All students will be encouraged to undertake an internship. The student must indicate their intention to undertake an internship in the first semester of their award; under exceptional circumstances this notification can be made later in the course. For more information: <http://www.keele.ac.uk/internships/>. Students participating in an appropriate internship would have their experience certified as postgraduate experience to enable them to provide this as evidence for the requirements of professional engineering training. Under the scheme operated by Keele University may be eligible for Institute of Leadership and Management (ILM) accreditation under the Keele University Skills Portfolio (KUSP) scheme.

The project dissertation is a major part of the award. Students are encouraged to select projects that are industry related in order to gain valuable industrial experience. The course team will utilise links with industry and public bodies to endeavour to develop potential project titles. Students should normally achieve a minimum of 120 credits, 60 of which must be the four compulsory Medical Devices Design modules, to be able to progress onto the dissertation module MTE-40015. Successful completion of this module provides the further 60 credits required to be eligible for the award of a Master's degree.

Students not reaching 120 credits at the first attempt may retake assessment according to University guidelines. Students who have failed an option module and are not able to retake said module may, with approval from the Course Director, replace this option with another. However, the maximum mark will be set at 50% and there will be an additional fee for the study of this replacement module: the four Medical Devices Design modules and the two conditional modules **cannot** be replaced in this manner.

A student progressing to MTE-40015 carrying one or more reassessments does so knowing that obtaining a pass mark in the project whilst not obtaining pass marks in compulsory modules will not constitute passing of the award. Students unable to attain the minimum of 120 credits may be transferred onto the PG Certificate stream and PG Diploma streams as appropriate. In both cases students will be able to make up any shortfall using the two modules: Independent Study (CLM-40085) and Research Practice (CLM-40064) Modules.

If a student fails the project module they may still be eligible for the award of a PgD.

Table 1: Award Structure related to Full Time and Part-Time pathways.

Module code	Module title (Semester)	FHEQ Level	Credit value	Compulsory (C) or optional (O)	Learning Outcomes
<i>COMPULSORY MODULES</i>					
MTE-40045	Medical Devices Design: Design Control Methodologies	7	15	C	1,5-7,11-13,14
MTE-40047	Medical Devices Design: Advanced Materials and Manufacturing	7	15	C	1-5,9,11,12,14
MTE-40051	Medical Devices Design: Quality by Design	7	15	C	1,5-7,11-13,14
MTE-40049	Medical Devices Design: Regulatory Frameworks	7	15	C	1-5,9,11,12,14
MTE-40039	Experimental research Methodology	7	15	C	4,10,14
MTE-40015	Project (dissertation)	7	60	C	4,8,9,10,11,12
MTE-30003	Engineering for Medical Applications ** Students may be eligible for exemption depending on previous study (section 2.2) A replacement option module will be required	6	15	C	1
<i>OPTION MODULES** (Select 2)</i>					
MTE-40036	Biomaterials	7	15	O	6,7
MTE-40023	Biomechanics	7	15	O	6,7
MTE-30001	Human Physiology and Anatomy* ** Students with no anatomy in previous studies should take this option	6	15	O	6,7
MTE-40024	Human Physiology and Anatomy*	7	15	O	6,7
MTE-40026	Physiological Measurement	7	15	O	6,7
ESC-40031	Clean and Green Technologies I +	7	15	O	6,7
ESC-40030	Case Studies in Sustainability +	7	15	O	6,7
ESC-40047	Green IT+	7	15	O	6,7
ESC-40032	Clean and Green Technologies II+	7	15	O	6,7

*Disqualified combination: take L7 module if you have studied anatomy before.

** Note level 6 modules do not count to your overall classification, they are only included in the credit total to ensure a total of 120 credits has been achieved.

+ Runs within Faculty Natural Sciences, contact Dr Sharon George.

++ These are preferred option modules; if you wish to study any other L7 module from the diet available at Keele you may do so but only with approval from the Award Director.

4. How is the Programme assessed?

A variety of assessment methods are used across the programme. These include coursework-based essays, written examinations, reports on laboratory-based practical, essay-based examination, interactive oral presentations, and a dissertation based on the student research project.

Clear marking guidelines accompany each mode of assessment where a mark of 50% or above is required to achieve a pass.

Through adoption of the above assessment methods students are given an opportunity to display achievements spanning knowledge and problem-solving abilities, communication and research skills, development of practical skills, and critical thinking.

Formative assessment occurs in a continuous process driven by lecturer-led sessions, one-on-one mentoring, and lecturer-led discussions accompanying taught materials.

5. What are the typical admission requirements for the programme?

Applicants should have, or expect to achieve, a minimum of a lower second-class honours degree in a relevant⁵ scientific or technical discipline.

In exceptional circumstances students with appropriate professional qualifications and/or work experience may be accepted at the University's discretion.

Students whose first language is not English must hold an acceptable qualification in English to a minimum of IELTS 6.5.

6. How are students supported on the programme?

Support is provided throughout the study period with a broad range of student-centric activities.

Initial support is provided during the **Induction Week** where orientation, study skills introductions, and welcoming events are held: led by the course and the university. Accompanying these events the course handbook, which students receive on their first day details key course information, module structure, module content, assessment formats, and relevant University regulations.

All students are allocated a personal tutor at the beginning of the course. This offers an individual resource for assistance with both academic and personal issues where detrimental impacts on academic outputs can develop. Student-mentor meetings occur twice a semester unless special needs require a greater frequency. More information is available in the *University's Personal Tutoring Policy* document.

Students for whom English is not their first language are offered language classes, facilities and services by the University's Language Centre. In addition to credit-bearing postgraduate modules on English for academic study, students also have access to one-to-one tutorials for individual help and advice, and to a wealth of resources for self-study and practice. Incoming non-native English speaking students take a diagnostic English language assessment during their first week at Keele, after which personalised recommendations for modules or other forms of support are made.

7. Learning Resources

This course is based within the School of Pharmacy and Bioengineering, primarily based at the Guy Hilton Research Centre (GHRC).

The administration team are based on Keele's main campus within the Hornbeam Building.

⁵ Within the context of this submission "relevant" means any STEM degree or one that contains elements of STEM study and relevance is at the discretion of the Course Director.

Teaching delivery will be held in GHRC, on Keele Campus, the Royal Stoke University Hospital site, at external sites, and on industrial premises.

Students on this award are Keele students and have access to all the facilities that title conveys. In particular students have access to a Computer Room at the GHRC and extensive IT facilities on the main campus; the Health Library on the hospital site, and the University library located on the main campus. The main library, for example, houses study spaces that can be used for group work.

On-line, physical and electronic data sources area available through Keele University Library. In addition, students on this award may use the Health Library cited at the Royal Stoke University Hospital.

8. Other learning opportunities

Opportunities exist for research projects to be performed at other institutions either by prior arrangement or through regular offerings such as at the Robert Jones and Agnes Hunt Hospital, Oswestry and the University Hospitals of North Midlands Trust.

Students are encouraged to undertake a modern foreign language to support the CV. These are offered by Keele Languages Centre.

9. Quality management and enhancement

The programme is managed by the School of Pharmacy and Bioengineering Courses Committee, which incorporates both course leaders and students. This, in turn, is accountable to the School of Pharmacy and Bioengineering Learning and Teaching Committee, which resides within the Faculty of Medicine and Health Sciences.

Further levels of accountability and development are inbuilt through regular student feedback, module evaluation questionnaires, biannual Examinations Boards, biannual External Examiners reports, and on-going staff development programmes.

10. The principles of programme design

The MSc in Medical Engineering Design has been developed to meet the aspiration of the Higher Education Funding Council for England to increase the number of students exiting with an engineering qualification, but not necessarily having a first degree in engineering.

It has also been developed with an aspiration for it to meet the requirements⁶ of the Engineering Council UK-Spec as a “*matching section*” towards professional engineering qualifications for those with an accredited first degree in engineering.

<http://www.engc.org.uk/UKSPEC>

The following documents, guidelines and information sources have been used in the design process.

Transition to engineering. Engineering council.

<http://www.hefce.ac.uk/pubs/rereports/Year/2015/Engineering/Title,105476,en.html>

Keele Careers and Employability service Internships.

<https://www.keele.ac.uk/careers/internships/>

11. Programme Version History

Version History	Date	CHANGES / NOTES
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⁶ Subject to accreditation by a Professional Engineering body.

Date first created	Feb 2016	
Revision history	10 January 2017 12 January 15 th Feb 2022	Following internal scrutiny panel Following comments Restructure for Sept/Jan Start
Date approved	June 2022	