Module Specification

Module Summary Information

1	**Module Title**	Research Methods in Science and Engineering
2	**Module Credits**	20
3	**Module Level**	5
4	**Module Code**	ENG5108

5	**Module Overview**

Rationale:

If conducted in the right way biomedical engineering research and design of medical devices will contribute to improved healthcare and quality of life, but too much time and resources are wasted on badly designed and conducted research. This module is designed to give you the necessary skills and knowledge required to design, execute and disseminate a research project in biomedical engineering. It will prepare you to critically analyse scientific/medical/engineering research literature, to assess ethical aspects, like fraud, plagiarism and medical and academic misconduct, to develop a devise design and evaluate design quality, and will develop essential skills in data management, statistical analysis, scientific writing, presentation and publishing skills. It will build upon the professional methods already applied in various first year modules, but will focus on learning to take decisions for the why and how of doing research and development yourself and will set you up to be effective and successful in your level 6 individual research project.

Alignment with Programme Philosophy and Aims:

Although focussed on your development into an independent, investigative biomedical engineer, many of the learning outcomes feed directly into developing key transferable skills that enhance employability. Critical appraisal of current knowledge, advanced analytical and presentation skills are invaluable assets or many professional careers. Classroom and on-line activities encourage reflect on the scientific and ethical issues encountered in the healthcare setting. By acquiring skills in tested and internationally accepted research methods you open up a global career opportunity.

Learning and Teaching Strategy:

You will be taught using a blended approach of interactive lectures, workshops and computer-based tutorials. Your learning will be supported by online resources on Moodle, dedicated to prepare yourself for the taught sessions to optimise their impact. You will test your understanding in formative online quizzes. In the computer-based tutorials you will develop quantitative analysis skills and apply it to elements of your assessment. The post-session online reflective journal entries will encourage you to reflect on what you have learned in the session and employ the theoretical knowledge and understanding in Biomedical Engineering post-session applications. Active and informed participation through pre- & post-sessional work will be an integral component of the module. Such engagement will enhance the learning experience of you and your peers.

To achieve the required 20 credits for this module, you will need to dedicate at least 200 hours studying the module material. For this module, the time is broken down in an approximately 25:75 ratio (directed: self-directed). The scheduled learning activities will include lectures, tutorials, practical sessions and facilitated discussions; approximately 20% of this learning will take place in an online environment.

Assessment Strategy

Writing a research proposal to test the quality of a new devise design requires to engage with all the elements in the module, from research philosophy to power calculations. An operational hypothesis needs to be defined, based on critical appraisal of relevant literature and quantitative analysis of pilot data. This will lead to a choice of experimental design and statistical approach based on a balanced cost-benefit analysis. This allows you to get actively engaged with the design, conduct and analysis in your research placement and prepares you for doing research independently, irrespective of the research area.

6	Indicative Content
Introduction to module and assessment. Overview of research and development process. Conceptualisation and medical imaging-based modelling. Computational modelling. Qualitative research methods. Device application 1. Critical appraisal of literature. Designing quantitative research for evaluation and testing. Data handling and presentation. Descriptive statistics. Accuracy, reliability and managing variability. Ethics in research (including animal research). Basic inferential statistics. Advanced inferential statistics. Device application 2. Patch 2 tutorial. Power calculations. Clinical research and Human ethics. Scientific communication and referencing. Design evaluation and optimisation (ISO 9000). Device application 3. Patch 3 tutorial. Engineering and product management. Prototyping, patent and marketing. Device application 4. Patch 4 tutorial.	

7	Module Learning Outcomes On successful completion of the module, students will be able to:	
	1	Critically appraise relevant current literature in order to formulate an operational research hypothesis.
	2	Systematically analyse ‘raw’ data to demonstrate competency in descriptive and interference statistics in order to draw a preliminary conclusion.

	3	Justify the chosen experimental design and discuss the best analytical approaches in order to optimise the statistical power.
	4	Demonstrate a critical awareness of the ethical, financial, time management aspects in order to make a balanced cost-benefit analysis.

8	**Module Assessment**		
Learning Outcome			
	Coursework	**Exam**	**In-Person**
1,2,3,4	**x**		

9	**Breakdown Learning and Teaching Activities**
Learning Activities	**Hours**
Scheduled Learning (SL) includes lectures, practical classes and workshops, peer group learning, Graduate+, as specified in timetable	55
Directed Learning (DL) includes placements, work-based learning, external visits, on-line activity, Graduate+, peer learning, as directed on VLE	0
Private Study (PS) includes preparation for exams	145
Total Study Hours:	200