

Module Template for New and Revised Modules

Module Code	MEP56BM8
Module Name	Active Implanted Devices and Systems
ECTS Weighting¹	10 ECTS
Semester taught	Semester 2
Module Coordinator/s	Assistant Professor Alejandro Lopez Valdes
Module Learning Outcomes with reference to the Graduate Attributes and how they are developed in discipline	<p>On successful completion of this module, students should be able to:</p> <p>LO1 Understand the concepts involved in implanted devices and systems. LO2 Be able to perform quantitative analysis of data from implanted systems. LO3 Be able to design and implement signal processing algorithms for chronically implanted systems. LO4 Be able to identify, formulate and adapt engineering solutions to unmet biological needs. LO5 Be able to propose research ideas for the development or improvement of active implanted devices and systems.</p> <p>Graduate Attributes: levels of attainment</p> <p>To act responsibly - Enhanced To think independently - Enhanced To develop continuously - Enhanced To communicate effectively - Enhanced</p>
Module Content	<p>The objective of this module is to provide a quantitative background to active implanted neural systems. Focus will also be placed on the neuromodulation effects of electrical stimulation and on the goals of real time, closed loop control of implanted system. The module will be based around a substantial individual assignment (grant proposal) and lectures based on state-of-the-art publications.</p> <p>Topics to cover:</p> <ol style="list-style-type: none">1) Fundamental of Recording:<ul style="list-style-type: none">• Principles of Recording neural activity• Recording neural activity in freely moving animals• Neural Spike trains and Analysis2) Fundamental of Neuromodulation<ul style="list-style-type: none">• Principles of Electric Field Generation for Stimulation of CNS• Mechanism of Action of Deep Brain Stimulation• Computational Modelling of Deep Brain Stimulation3) Biomedical Engineering and Neuroscience Considerations<ul style="list-style-type: none">• Electrodes for the Neural Interface• Implantable microelectrodes• Implantable Neural Stimulators

- Nonlinear dynamical modelling
 - Closed loop control
- 4) Clinical Applications of Neuromodulation
- Neuromodulation for Movement Disorders
 - Neuromodulation for Psychiatry
 - Neuromodulation for Functional Restoration: Hearing
 - Deep Brain Stimulation for Cognitive Modulation
 - Regulatory Approval of Implantable Medical Devices

Teaching and Learning Methods

The module will be based on the combination of podium lectures, group discussion and a substantial individual assignment. In the event of a COVID-19 lockdown, the teaching methods for this module may have to be revised. Your module coordinator will keep you updated.

Assessment Details²

Please include the following:

- **Assessment Component**
- **Assessment description**
- **Learning Outcome(s) addressed**
- **% of total**
- **Assessment due date**

Assessment Component	Assessment Description	LO Addressed	% of total	Week due
Individual/Group Assignments	Development of a research proposal around state-of-the-art Active Implantable Devices.	L01-L05	75%	26,29,33
Individual Assignment	End of module assignment demonstrating integration of knowledge acquired in the field of novel active implantable devices. Due end of semester	L01-L05	25%	35
Attendance	Students may be deemed non-satisfactory and penalized on their final mark or not eligible to sit the exam if they attend less than 80% of lectures (except for in case of valid medical note).			

Reassessment Requirements

Reassessment will consist of a 2hr written examination worth 100% of the mark.

Contact Hours and Indicative Student Workload²

Contact hours: 33.
Independent Study (preparation for course and review of materials): 66 hours: Researching journals, reviewing lecture material and class notes.
Independent Study (preparation for assessment, incl. completion of assessment): 66hours: Searching, locating, retrieving, analysing, synthesising, discussing research literature related to the chosen topic for the project assignment. Writing of the project report in the form of a research proposal to a funding agency. Preparation of 10min presentation.

Recommended Reading List	<ul style="list-style-type: none"> • Prostheses for the brain : introduction to neuroprosthetics / Andrej Kral, Felix Aplin, Hannes Maier. (2021) • Implantable electronic medical devices / Dennis Fitzpatrick. (2014)
Module Pre-requisite	EEU33BM1 Anatomy and Physiology, PG7901 Form and Function of Nervous System and EEU44C05 Digital Signal Processing, Processing; or equivalent knowledge plus supplementary reading as advised by module coordinator.
Module Co-requisite	
Module Website	Blackboard
Are other Schools/Departments involved in the delivery of this module? If yes, please provide details.	Guest lectures from School of Medicine and School of Psychology
Module Approval Date	
Approved by	
Academic Start Year	2021
Academic Year of Date	2024-25