<table>
<thead>
<tr>
<th>Module Code</th>
<th>5BIO8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module Name</td>
<td>Implanted Devices and Systems</td>
</tr>
<tr>
<td>ECTS Weighting</td>
<td>10 ECTS</td>
</tr>
<tr>
<td>Semester taught</td>
<td>Semester 2</td>
</tr>
<tr>
<td>Module Coordinator/s</td>
<td>Prof Richard Reilly</td>
</tr>
</tbody>
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**Module Learning Outcomes** with reference to the **Graduate Attributes** and how they are developed in discipline:

On successful completion of this module, students should be able to:

- **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.

**Graduate Attributes: levels of attainment**

- To act responsibly - Enhanced
- To think independently - Enhanced
- To develop continuously - Enhanced
- To communicate effectively - Enhanced

**Module Content**

The objective of this module is to provide a quantitative background to 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.

**Section 1 Fundamental of Recording:**
- Principles of Recording neural activity
- Recording neural activity in freely moving animals
- Neural Spike trains and Analysis

**Section 2 Computational and Mathematical Modelling of Neural Systems**
• Biological and theoretical neural networks
• Information processing in complex systems
• Learning models; Reinforcement learning
• Self-organization in nervous system
• Synchronization of oscillators in memory formation

Section 3 Fundamental of Neuromodulation
• Principles of Electric Field Generation for Stimulation of CNS
• Mechanism of Action of Deep Brain Stimulation
• Computational Modelling of Deep Brain Stimulation

Section 4 Biomedical Engineering and Neuroscience Considerations
• Electrodes for the Neural Interface
• Implantable microelectrodes
• Implantable Neural Stimulators
• Nonlinear dynamical modelling
• Closed loop control

Section 5 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.
## Assessment Details

Please include the following:

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

<table>
<thead>
<tr>
<th>Assessment Component</th>
<th>Assessment Description</th>
<th>LO Addressed</th>
<th>% of total</th>
<th>Week due</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual assignment</td>
<td>Submission of a proposed new implanted device or system. Due end of semester</td>
<td>L01-L04</td>
<td>75</td>
<td>32</td>
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<tr>
<td>Examination</td>
<td></td>
<td>L01-L04</td>
<td>25</td>
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### Contact Hours and Indicative Student Workload

**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):** 66 hours. 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

- 3BIO1 Anatomy and Physiology, 4C5 Digital Signal Processing

### Module Website

- Blackboard

### Are other Schools/Departments involved in the delivery of this module?

- NO
Academic Year of Date