**7B9 NEURAL ENGINEERING** [5 credits]

**Lecturers:** Professor Richard Reilly, School of Medicine, School of Engineering

**Semester:** 2

**Module Organisation**

The module runs for 2 weeks of the academic year and comprises 12 lectures per week. Total contact time is 24 hours.

**Module Description**

The purpose of this module is to introduce students to the field of neural engineering from a neuroscience perspective. Students will apply engineering principles to understand the excitation of nerve and muscle, the generation of bioelectric signals and artificial stimulation of biological tissues. Common methods of stimulating, recording and analysing neural systems will be examined. The basic principles and methods studies will then be applied to examine specific neuroscience applications of neural engineering, such as biomarkers for neurological and neuromuscular disorders.

**Prerequisites:** 3Bio1 Anatomy and Physiology.

**Learning Outcomes**

On successful completion of this module, students should have developed:

1. Understanding of monitoring of neural activity
2. Understanding of central nervous system
3. Ability to understand neural processes and its applications to neural engineering
4. Insight on biomaterial properties and integration of biomaterials as implanted systems
5. Ability to integrate the knowledge on central nervous system and the development of neural engineering applications
6. Ability to design and conduct experiments, as well as to measure, analyse and interpret data from living systems.
7. Ability to function on multidisciplinary teams
8. Ability to identify, formulate and adapt engineering solutions to unmet biological needs
9. Ability to model and analyze biological systems as engineering systems
10. Knowledge of the commercial market and understanding of the regulatory hurdles in neural engineering
11. Ethical issues and considerations for neural engineering
Module Content

- Review of relevant neurophysiology and neuroanatomy
- Electrical properties of neurons

Section 1 Monitoring Neural Activity

- Monitoring neural activity: Bioelectric potentials and currents I
- Action potentials
- Implantable microelectrodes
- Neural Spike trains and Analysis
- Electroencephalography EEG
- EEG Recording and Analysis with application to Schizophrenia
- EEG Recording and Analysis with application to Movement Disorders
- Non-invasive Brain Machine Interfaces
- Invasive Brain Machine Interfaces
- Magnetic stimulation of biological tissues

Section 2 Replacing/Restoring Neural Function

- Electric stimulation of biological tissues
- Deep brain stimulation
- Retinal and Visual Prostheses
- Cochlear Implants and Auditory Prostheses

Module Notes
Provided via Blackboard

Teaching Strategies

The module is taught using a combination of lectures and assignment. Each student will undertake a laboratory assignment involving data acquisition write an independent report, which introduces the student to research skills necessary for life-long learning.

Assessment Modes

Written Exam (70%) and learning assignment (30%).

Recommended Texts

- Neural Engineering He (ed), Springer 2013
- Neural Engineering Eliasmith, Anderson, MIT Press