Module Code	MEP55B21
Module Name	Neural Signal Analysis
ECTS Weighting[1]	10 ECTS
Semester taught	Semester 1
Module Coordinator/s	Assistant Professor Alejandro Lopez Valdes
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. Describe the origin and imaging methods of neural signals. LO2. Apply quantitative analysis methods to dynamic, multivariate neural data. LO3. Desing electroencephalography data acquisition experiments with reliable stimulus presentation and signal quality. LO4. Design analysis pipelines and analyse EEG and event-related potential data with time-frequency methods. LO5. Conduct and interpret analyses of structural and functional MRI data. LO6. Critically evaluate and apply analysis frameworks for connectivity and modelling on neural systems. **Graduate Attributes: levels of attainment** To act responsibly - Enhanced To think independently - Enhanced To develop continuously - Enhanced To communicate effectively - Enhanced
Module Content	The purpose of this module is to equip students with advanced mathematical tools for the analysis of neural signals including EEG, MEG, fMRI, and intracranial data. The tools will include harmonic analysis, filtering, independent component analysis and wavelet-based methods. All methods will be developed to answer specific physiological questions on real data sets. The lectures will be accompanied by MATLAB based analysis assignments throughout the semester. The scoring of the module will encourage this practical application of the methods with continuous MATLAB based assignments comprising 100% of the module mark. • The analysis of linear time-invariant systems as applied to electrophysiology. • Noise and filtering for electrophysiological data. • Electroencephalography: generators, analysis, and interpretation. • Intracranial data: sources, interpretation, and analysis. • Functional magnetic resonance imaging: origin of the BOLD signal and its analysis. • Estimating neural connectivity patterns from neural data. • Computational modelling of neural systems.

Teaching and Learning Methods

The course is lecture based, but a large emphasis is placed on accompanying MATLAB-based assignments. These assignments will involve applying methods discussed in lectures to real neural data.

Students will be expected to complete an extensive training in recording of high-quality EEG data. This will involve multiple recording sessions on volunteer subjects so that they demonstrate competence in recording and data analysis.

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 Details
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 assignments	Submission of Course Assignments	L01-L05	100	5,8,11, 14
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 an assignment worth 100% of the module.

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, and implementing mathematical solutions or assignments. Writing of the assignment reports and discussing conclusions.

Recommended Reading List

1. Signal Processing for Neuroscientists: Introduction (2006) & Companion Volume (2010) by van Drongelen.
2. Spikes: Exploring the Neural Code by Rieke (1999).
3. Analyzing Neural Time Series Data by Cohen (2014).

Module Pre-requisite

EEU33BM1 Anatomy and Physiology (or supplementary reading on form and function of the nervous system as advised by module coordinator) **and** EEU44C05 Digital Signal Processing.

Module Co-requisite

Module Website

Blackboard

Are other Schools/Departments involved in the delivery of this module? If yes, please provide details.	Guest lectures by the School of Computer Science and School of Medicine
Module Approval Date	
Approved by	Prof. Naomi Harte
Academic Start Year	September 2025
Academic Year of Date	2025/2026