MRes Neurotechnology Programme Syllabus 2019-20

Module Weightings		
Element	Module	% Module Weighting
Taught Element (22%)	Neuroscience	33.3r%
	Statistical and Computational Methods for Research	33.3r%
	Frontiers in Neurotechnology Research	33.3r%
	Topics in Neural Engineering	0%*
Research Element (78%)	Planning report	13.3r%
	Poster presentation	13.3r%
	Thesis	60%
	Oral presentation	13.3r%

* assessment for Topics in Neural Engineering is pass/fail only and does not contribute to the degree mark

In addition to the above, all postgraduate students are required to take the compulsory online course in plagiarism awareness and at least 2 professional skills courses run by the Graduate School

Module descriptions

BIOE97048: Neuroscience

Course Aim
The aim of the course is to introduce students to the key principles and methods of neuroscience, covering multiple levels of organisation, from molecules to behaviour.

Syllabus
(1) Fundamentals: anatomy of neurons and the human brain; electrical properties of excitable cells (membrane potential, the action potential, Hodgkin and Huxley models, axon and dendrites: the cable equation); synapses (structure and function, quantal chemical transmission, ionotropic/metabotropic receptors, synaptic excitation and inhibition, electrical synapses, postsynaptic integration, plasticity and learning); sensory transduction (from detector to brain: vision, audition, olfaction); neuromodulatory systems; neuro-glial interactions, motor control; pain (cellular and systems mechanisms), active sensing, attention.

(2) Technology for Neuroscience: model systems; molecular tools (genetic manipulation, e.g., knock-out/knock down, opto- and pharmaco-genetics, fluorescent indicators); modern electrophysiology and imaging methods.

Pre-Requisites
None

Learning Outcomes
Knowledge and Understanding

- Understanding key concepts concerning the physiological basis of electrical and chemical signalling in the nervous system.
- Knowledge of some generic principles by which neuronal circuits process sensory and motor information.
- Appreciation of how physiological signals can help us to understand motor and sensory systems, and how engineering and statistical approaches help in the analysis of such data
- Knowledge of the current level of development of the field of Neuroscience
- Appreciation of the relationship between fundamental neuronal properties and whole organism behaviour in both health and disease

Intellectual Skills

- Appropriate formulation of hypotheses for scientific research
- Critical appraisal of original research – technical and conceptual

Practical Skills

- Basic knowledge of neuroscience tools
- Anatomical identification of major brain structures

Transferable Skills

- Multi-level approaches to problem solving

Teaching Methods
Lectures: 18 hours
Labs: 9 hours

Assessment
Written exam: 100%% weighting
Students have 1.5 hours to complete the exam. Each question will consist of sub-questions, including multiple-choice questions, and is worth 100 marks. Answer all questions concisely.

Outline answers to past papers will be available

BIOE97142: Statistical and Computational Methods for Research

Course Aim
This course will introduce statistically based experimental design. The aim is to provide students with tools to inform their project design, data collection and to assist in data analysis. Programming techniques will be taught using Python and Jupyter to process data, produce statstical comparisons and develop plots to a publication standard.

Syllabus
Statistics and Experimental Design:
Understanding of critical data parameters
Calculation of statistical values from data populations
Calculation of t-tests, ANOVAs, power calculations, and achieving statistical power
Experimental desing with appropriate repeats

Python programming:
Fundamental skills in using Python including:
Syntax
Logic
Functions
Data import and export
Arrays and data structures

Jupyter Notebook:
Using Jupyter for statistical analysis and data visualisation

Learning Outcomes
Knowledge gained on experimental design and statistical treatment will be used to support students through their projects and ensure adequate data collection and analysis. This will enable students to evaluate data collection and analysis more widely, and design their own experiments to answer speicfic research questions. The knowledge gained in the lectures will be consolidated through GTA-supported lab sessions (also in computer rooms). Students will gain skills in experimental design, statistical analysis, programming and data presentation. The module will be delivered in a hands-on and interactive approach, with sessions in the computer room so that students can test and practise the code and/or approaches that they have been shown. Skills in experimental design, programming and data analysis will be transferable across information gathering, problem solving, language and information technology.

Teaching Methods
Lectures: 18 hours
Labs: 18 hours

Assessment
There is no exam in this module.
Coursework:
MCQ on Statistical Methods and Theory 33%
Progress test on Programming Basics 33%
Lab report on Jupyter Notebook 34%

BIOE97147: Frontiers in Neurotechnology Research

Course Aim
The aim of this module is to introduce students to the breadth and variety of research in Neurotechnology, and to develop their presentation skills, writing skills and critical analysis skills.

Syllabus
Monthly research seminars, covering a broad range of interdisciplinary topics in Neurotechnology.
A weekly journal club (in semester 1) in which students have to argue for or against neurotechnology research papers

Learning Outcomes
To critically appraise the quality and rigour of a piece of research
To assess the relevance and applicability of others research in the context of the student's research project
To evaluate the quality of a presentation and its delivery
To present clearly and concisely on a research related topic
To write clearly and concisely on a research related topic
To be able to do a broad literature search, compare the outputs found, and judge which are most relevant and worthy of discussion

Teaching Methods
Seminars will be delivered in lecture format by Imperial and world-leading external researchers, over term 1 and term 2.
Journal clubs will be delivered through small group teaching (seminar format) in the MRes cohort.

Assessment
Assessment 1 (50%): Journal club presentation
Students will choose a research paper and have to critically assess the merits and limitations of the paper and present their summary to their cohort, for group discussion. Students will be assessed based on their presentation, their demonstrated knowledge of the content of the paper, their critical analysis of the paper, and their ability to answer and respond to questions.
Assessment 2 (50%): Seminar report
Students will choose one of the seminars attended during the year and write a report summarising the content of one of the seminars attended throughout the year, describing the significance of the research presented and broad explanation of the context, rationale and methodology, a critical overview of the results and approach, and the importance of the research area in the broader sense.

BIOE97146: Topics in Neural Engineering

Course Aim
This module exposes MRes student to the broad range of level 7 modules offered to Master's students in Biomedical Engineering/Bioengineering. MRes students choose two level 7 courses based on relevancy to their specific research project.

Syllabus
Descriptions of available modules will be made available online at the start of the academic year. The module aims to broaden students' knowledge in topics associated with the subject area of their project. The suitability of modules will be determined in consultation with the student's supervisor.

Learning Outcomes
Students will demonstrate the ability to evaluate, integrate, and apply appropriate information from various sources to create cohesive, persuasive arguments, and to relate those concepts to their own research project and plans.
Students will appraise the breadth and interdisciplinary nature of the neural engineering field
Students will communicate effectively with classmates from different backgrounds
Students will evaluate the content delivered and assess the relevance to their project in the form of concise reports

Teaching Methods
You will be taught over one term using a combination of lectures, group experiences and practical computer labs. Lecture sessions will be made available on Panopto for review. Group sessions will be based on the practical application of taught content from lectures to complement these topics and allow students to grow their understanding in a student-led manner.

Assessment
Assessment will be performed via two reports (one for each module chosen). The reports will summarise students' learning of that course and highlight in which ways the course was particularly relevant to their research project.