BMEN90002 Neural Information Processing

Credit Points:	12.5
Level:	9 (Graduate/Postgraduate)
Dates & Locations:	2015, Parkville This subject commences in the following study period/s: Semester 2, Parkville - Taught on campus.
Time Commitment:	Contact Hours: 3 hours lecture, one hour tutorial per week and up to 24 hours of laboratories. Total Time Commitment: 200 hours
Prerequisites:	Prerequisite for this subject is:

Subject	Study Period Commencement:	Credit Points:
BMEN30006 Circuits and Systems	Semester 1	12.50

(prior to 2015 BMEN30006 Fundamentals of Biosignals)

OR

Subject	Study Period Commencement:	Credit Points:
ELEN30012 Signals and Systems	Semester 2	12.50

OR

equivalent

Corequisites:	None
Recommended Background Knowledge:	None
Non Allowed Subjects:	Anti-requisites for this subject are: BMEN30001(431-336) Neurons: From Action Potential to Learning

Subject	Study Period Commencement:	Credit Points:
BMEN90004 Advanced Neural Information Processing	Not offered 2015	12.50

Core Participation Requirements:	For the purposes of considering request for Reasonable Adjustments under the Disability Standards for Education (Cwth 2005), and Students Experiencing Academic Disadvantage Policy, academic requirements for this subject are articulated in the Subject Description, Subject Objectives, Generic Skills and Assessment Requirements of this entry. The University is dedicated to provide support to those with special requirements. Further details on the disability support scheme can be found at the Disability Liaison Unit website: http://www.services.unimelb.edu.au/disability/
Coordinator:	Prof David Grayden
Contact:	Assoc Prof David Grayden Email: **grayden@unimelb.edu.au (mailto:grayden@unimelb.edu.au)**
Subject Overview:	**AIMS**

	This subject introduces students to the basic mechanisms of information processing and learning in the brain and nervous system. The subject builds upon signals and systems modelling approaches to demonstrate the application of mathematical and computation modelling to understanding and simulating neural systems. Aspects of neural modelling that are introduced include: membrane potential, action potentials, neural coding, neural models and neural learning. The application of neural information processing is demonstrated in areas such as: electrophysiology, and neuroprostheses. Material is reinforced through MATLAB and/ or NEURON based laboratories. **INDICATIVE CONTENT** Topics include: Neural information processing analysed using information theoretic measures; generation and propagation of action potentials (spikes); Hodgkin-Huxley equations; coding and transmission of neural information (spiking rate, correlation and synchronisation); neural models (binary, rate based, integrate & fire, Hodgkin-Huxley, and multicompartmental); synaptic plasticity and learning in biological neural systems (synaptic basis of learning, short term, medium term and long term, and rate based Hebbian learning models); spike-timing dependent plasticity (STDP) of synapses; higher order neural pathways and systems (cortical structure and circuits).
Learning Outcomes:	**INTENDED LEARNING OUTCOMES (ILO)** On successful completion of this subject, students should be able to: 1. Describe the structure and function of the nervous system; 2. Calculate equilibrium neural properties; 3. Describe the types and properties of synapses; 4. Describe the membrane mechanisms underlying the generation of action potentials; 5. Interpret neural responses in terms of point processes (Poisson); 6. Evaluate neural processing using information theoretic measures; 7. Implement and analyse the input-output characteristics of simple and biologically-detailed neural models; 8. Describe the principles underlying the analysis of biological neural signals; 9. Describe the mechanisms underlying learning in the brain and nervous system; 10. Describe higher-order neural pathways and systems.
Assessment:	One mid-semester examination of one hour duration (10%); Attendance and participation in four laboratory classes in Weeks 4 to 12, each with a written assignment of approximately 1000 words and requiring approximately 13-15 hours of work including preparation (10% each). ILOs 2, 5, 6 and 7 are addressed in these laboratory classes One end-of-semester examination of two hours duration (50%). Hurdle requirement: Students must pass the end of semester examination to pass the subject. Intended Learning Outcomes (ILOs) 1, 2, 3, 4, 5, 6, 8, 9 and 10 are assessed in the mid-semester test and final written exam. ILOs 2, 5, 6 and 7 are assessed in the submitted laboratory reports.
Prescribed Texts:	None
Breadth Options:	This subject is not available as a breadth subject.
Fees Information:	Subject EFTSL, Level, Discipline & Census Date, http://enrolment.unimelb.edu.au/fees
Generic Skills:	# Ability to apply knowledge of science and engineering fundamentals # Ability to undertake problem identification, formulation, and solution # Ability to utilise a systems approach to complex problems and to design and operational performance # Ability to conduct an engineering project
Notes:	**LEARNING AND TEACHING METHODS** The subject is delivered through lectures, tutorials and computer laboratory classes. **INDICATIVE KEY LEARNING RESOURCES** Students are provided with lecture slides, tutorials and worked solutions, laboratory sheets, and reference text lists.

	CAREERS / INDUSTRY LINKS Exposure to neural information processing in industry is provided through research laboratory visits to medical research institutes and guest lectures by representatives of industry, hospitals and research institutes.
Related Course(s):	Master of Biomedical Engineering Master of Philosophy - Engineering Ph.D.- Engineering
Related Majors/Minors/ Specialisations:	Master of Engineering (Biomedical with Business) Master of Engineering (Biomedical)