

Subject Description Form

Subject Code	BME42129
Subject Title	Neuroengineering
Credit Value	3
Level	4
Prerequisite	BME31103 Applied Electrophysiology
Objectives	To provide students the principles of computational neuroscience and their applications in current and future technologies of neural rehabilitation and healthcare; and to develop students' ability to trace the advances of technologies in the field.
Intended Learning Outcomes	<p>Upon completion of the subject, students will be able to:</p> <ol style="list-style-type: none"> a. Understand the fundamental coding and modeling theories in the nervous systems; b. Understand the basic methods of information processing for neural decoding in the sensorimotor and central nervous systems; c. Learn and apply modeling and data analysis tools to real bio-signals; d. Describe and explain the principles of brain machine interface (BMI), neural prosthetics, functional magnetic resonance imaging, and electromagnetic recording/stimulation; e. Explore and trace the further development of neuroengineering technologies in the future.
Contribution to Programme Outcomes (Refer to Part I Section 10)	<ul style="list-style-type: none"> ▪ Programme Outcome 1: Demonstrate an ability to apply knowledge of mathematics, science, and engineering appropriate to the Biomedical Engineering (BME) discipline. (Teach and Practice) ▪ Programme Outcome 2: Demonstrate an ability to design and conduct BME experiments, as well as to analyze and interpret data. (Teach and Practice) ▪ Programme Outcome 3: Demonstrate an ability to design a system, component, or process relevant to BME to meet desired needs within realistic constraints, such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability. (Teach) ▪ Programme Outcome 4: Demonstrate an ability to identify, formulate, and solve BME problems. (Teach and Practice) ▪ Programme Outcome 5: Demonstrate an ability to understand the impact of BME solutions in a global and societal context, especially the

	<p>importance of health, safety, and environmental considerations to both workers and the general public. (Teach)</p> <ul style="list-style-type: none"> ▪ Programme Outcome 7: Demonstrate an ability to use the techniques, skills, and modern engineering tools necessary for BME practice. (Teach and Practice) ▪ Programme Outcome 8: Demonstrate an ability to use the computer/IT tools relevant to the BME discipline along with an understanding of their processes and limitations. (Practice) ▪ Programme Outcome 9: Demonstrate an ability to function in multi-disciplinary teams. (Practice) ▪ Programme Outcome 11: Demonstrate an ability to communicate effectively and advise clients, professional colleagues, and other members of the community. (Practice) ▪ Programme Outcome 12: Demonstrate an ability to recognize the need for, and to engage in life-long learning. (Teach and Practice) 									
<p>Subject Synopsis/ Indicative Syllabus</p>	<p>Clinical and diagnostic neuroengineering; circuit elements of the nervous and sensorimotor systems; biological neural networks; neural coding measurements and their processing: functional magnetic resonance imaging (fMRI); magnetoencephalography (MEG), electroencephalography (EEG), Electrocorticography (ECoG), Electromyography (EMG); neural prosthetics; brain machine interface (BMI); electromagnetic recording/stimulation: deep brain stimulation (DBS), and transcranial magnetic stimulation (TMS).</p>									
<p>Teaching and Learning Methodology</p>	<p>There will be lectures and group projects dealing with principles and examples of the application of neuroengineering. Students also will learn and design novel systems/methods under the supervision of the lecturer to explore their potential to invent. Grouped presentation and demonstration of their inventions will be evaluated by the lecturer and invited external professionals.</p>									
<p>Assessment Methods in Alignment with Intended Learning Outcomes</p>	<p>Specific assessment methods/tasks</p>	<p>% weighting</p>	<p>Intended subject learning outcomes to be assessed (Please tick as appropriate)</p>							
			<p>a</p>	<p>b</p>	<p>c</p>	<p>d</p>	<p>e</p>			
<p>Assignments</p>	<p>20%</p>		<p>√</p>	<p>√</p>	<p>√</p>	<p>√</p>				
<p>Group project</p>	<p>40%</p>		<p>√</p>	<p>√</p>	<p>√</p>		<p>√</p>			
<p>Final quiz</p>	<p>40%</p>		<p>√</p>	<p>√</p>	<p>√</p>	<p>√</p>				
<p>Total</p>	<p>100%</p>									

	<p>Note: To pass this subject, students must obtain grade D or above in both continuous assessment and final quiz.</p> <p><i>Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:</i></p> <p>Individual learning outcomes will be assessed as part of the integrated outcome demonstrated by the students in the written assignments and the grouped project. A final quiz will be used to establish that the student has understood and can integrate knowledge in neuroengineering to analyze the signals and solve problems.</p>	
Student Study Effort Expected	Class contact:	
	▪ Lecture	20 Hrs.
	▪ In class group project	19 Hrs.
	Other student study effort:	
	▪ Self-study	58 Hrs.
	▪ Preparation for the group project	20 Hrs.
	Total student study effort	117 Hrs.
Reading List and References	<ul style="list-style-type: none"> ▪ Bruce F. Katz, Neuroengineering the Future: Virtual Minds and the Creation of Immortality, 2008. ▪ IOP Publishing, Journal of Neural Engineering. ▪ BioMed Central, Journal of NeuroEngineering and Rehabilitation. ▪ IEEE, IEEE Transactions on Neural Systems and Rehabilitation Engineering. ▪ Hu Xiaoling, Intelligent Biomechatronics in Neurorehabilitation, Elsevier, 2019. 	
Date of Last Major Revision	10 August 2017	
Date of Last Minor Revision	20 December 2022	