EE445: Bioelectronics

Module Details

Title:	Bioelectronics REVIEWED
Long Title:	Bioelectronics
Language of Instruction:	English

Module Code:	EE445

Credits:	7.5

NFQ Level:	8

Field of Study:	Electronic Engineering

Valid From:	2017/18 (Sep 2017)

Module Delivered In	1 programme(s)

Administrator:	Noel Murphy

Module Coordinator:	Noel Murphy

Module Department:	20 - ELECTRONIC ENGINEERING

Module Description:	Bioelectronics is the application of the principles and technologies of electronic and computer systems, system modelling and electronic materials to biology and medicine, and the potential application of biological materials to solving information-processing problems. Its most immediate manifestation is in biomedical sensing and instrumentation, but a wide range of existing and potential application of electronics to biology and organic materials to information-processing problems are also part of this subject. It is a relatively new frontier for the attention of electronic and computer engineers, but its importance can only increase with the passage of time.

Learning Outcomes	
On successful completion of this module the learner will be able to:	
LO1	Explain and perform quantitative analysis on the physiological quantities and associated transducer characteristics that allow the sensing of clinically and health-related variables such as those relating to vital signs, metabolism, physical condition, physical activity, and bodily environment.
LO2	Design and implement appropriate electronic instrumentation and software for biosignal conditioning, amplification and digitization, and biosignal extraction or event detection relevant to clinical interpretation of data and diagnosis.
LO3	Design and conduct experiments, as well as measure, analyse, interpret and present data from living systems.
LO4	Model and analyze biological systems using the techniques of electronic and control engineering.
LO5	Explain and perform quantitative analysis on the interface between biological materials and micro- and nanoelectronics materials and devices, including the use of organic electronic material for such interfacing.
LO6	Explain commercial, regulatory, ethical and practical hurdles in the development of medical device electronics.

Pre-requisite learning
Module Recommendations *This is prior learning (or a practical skill) that is mandatory before enrolment in this module is allowed. You may not enrol on this module if you have not acquired the learning specified in this section.*
No recommendations listed
Co-requisite Modules
No Co-requisite modules listed
Pre-Requisite *This is prior learning (or a practical skill) that is mandatory before enrolment in this module is allowed. You may not enrol on this module if you have not acquired the learning specified in this section.*
No Pre-Requisites listed

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Module Content & Assessment

Indicative Content and Learning Activities
Measurable physiological properties and associated transducer characteristics Overview of physiological systems of the human body (cardiovascular, respiratory, nervous, skeletal, muscular, excretory, reproductive, regulatory); Sources of biomedical signals (electric, acoustic, mechanical, chemical, magnetic, optic, impedance); The human cell and action potentials; Sources of bioelectric potentials; Biopotential electrodes; Overview of other sensors/transducers used for biomedical sensing.
Biomedical instrumentation electronics Ideal op amps, general op amp circuits, sources of noise, biomedical pre-amplifiers, amplifiers and signal-conditioning.
Biosignal processing, filtering and event detection Filtering and frequency-based analysis of biosignals; Overview of basic pattern recognition and machine-learning techniques available for event detection on biosignals.
System modelling applied to biological systems including the immune system Systems Biology and multi-scale modelling; Control system modelling of biological systems; Computer simulation of cellular systems and metabolism; Protein folding simulation and its applications.
Information-theoretic models for biological information processing and (bio-)motor actuation Cognitive Neuroscience; Grossberg models of neural systems; Varela models of the Immune System; Information 'flow' in the human visual system.
The biomaterial-nanoelectronics interface and organic electronics An overview of recent developments in nanoelectronic devices for bio-interfacing; Implantable electronics for neural intervention in disease management; Interfacing with the brain using Organic Electronics
Commercial, regulatory, ethical and practical hurdles in the development of medical devices Electrical safety; Patient safety; Ethical issues; Regulatory issues; Data protection issues; The changing relationship between the patient and the medic.

Assessment Breakdown	%
Continuous Assessment	30.00%
End of Academic Session	70.00%

Continuous Assessment

Assessment Type	*Assessment Description*	*Outcome Addressed*	*% of total*	*Assessment Date*
In Class Test	There will be a short MCQ test at the beginning of each 3-hour lecture session to encourage students to engage with assigned reading and research relevant to the session topic.	1,2,3,4,5,6	12.00	n/a
Group project	Groups of students will be expected to work on assigned group projects that are likely to involve a mix of literature research, practical system design and implementation, testing and reporting on results.	1,2,3,4,5,6	18.00	Week 12

End of Module Formal Examination

Assessment Type	*Assessment Description*	*Outcome Addressed*	*% of total*	*Assessment Date*
Formal Examination	Three-hour written exam paper.	1,2,4,5,6	70.00	End-of-Semester

Reassessment Pre-Requisite

Repeat examination
Reassessment of this module will consist of a repeat examination. It is possible that there will also be a requirement to be reassessed in a coursework element.

Reassessment Description
The exam element of the module assessment will be reassessed by a resit exam in August. A combination of a single (larger) MCQ test and an individual student assignment may be used to reassess the CA element of the module assessment.

DCU reserves the right to alter the nature and timings of assessment

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Module Workload

Full Time hours per semester		
WorkLoad Type	*WorkLoad Description*	*Hours*
Lecture	No Description	36
Assignment Completion	No Description	20
Independent Study	No Description	132
	Total Hours	188.00

This module has no Part Time workload.

Module Resources

Supplementary / Recommended Book Resources

John G. Webster, editor; contributing authors, John W. Clark, Jr.... [et al.] 2010, *Medical instrumentation*, 4th Ed., John Wiley & Sons Hoboken, NJ [ISBN: 9780471676003]

C.R. Rao, S.K. Guha 2001, *Principles of Medical Electronics and Biomedical Instrumentation*, Universities Press,India [ISBN: 8173712573]

R. S. Khandpur 2005, *Biomedical instrumentation*, McGraw-Hill New York [ISBN: 0071447849]

Michael S. Gazzaniga, University of California, Santa Barbara; Richard B. Ivry, University of California, Berkeley; George R. Mangun, University of California, Davis., *Cognitive neuroscience*, New York; W. W. Norton & company, inc [ISBN: 0393913481]

Andreas Offenhäusser, Ross Rinaldi (Eds) 2010, *Nanobioelectronics - for Electronics, Biology, and Medicine*, Springer [ISBN: 978144191857]

This module does not have any article/paper resources

Other Resources

Website: Institute for Systems Biology*What is Systems Biology?*, Institute for Systems Biology
https://www.systemsbiology.org/about/wha t-is-systems-biology/

Website: Stephen Grossberg*Stephen Grossberg Academic Homepage*
http://cns.bu.edu/Profiles/Grossberg/

Website: Nelson Vaz*Francisco Varela and the Immunological Self*
http://www.academia.edu/4740894/Francisc o_Varela_and_the_Immunological_Self

Module Delivered In

Programme Code	*Programme Title*
	MEng in Electronic & Computer Engineering (Draft)

Module Managers & Teachers

Module Managers		
Semester	*Staff Member*	*Staff Number*
Semester 1	Noel Murphy	75006979
Semester 2	Noel Murphy	75006979
Autumn	Noel Murphy	75006979

Module Teachers	
Staff Member	*Staff Email*
No Teacher Staff Assigned	