City University of Hong Kong

Information on a Course offered by Department of Electronic Engineering with effect from Semester A in 2012/13

Part I

Course Title:	Topics in Bioelectronics and Biomedical Instrumentation
Course Code:	EE5416
Course Duration:	One Semester (13 weeks)
No. of credits:	3
Level:	5
Medium of Instruction:	English
Prerequisites:	EE3110 Analog Electronic Circuits; or equivalent
Precursors:	Nil
Equivalent Course:	Nil
Exclusive Courses:	Nil

Part II

Course Aims:

The course aims to provide students with applied knowledge in sensory physiology including structure and function in the development of diagnostic and therapeutic bioelectronics devices and biomedical instrumentations.

Course Intended Learning Outcomes (CILOs)
Upon successful completion of this course, students should be able to:

No.	CILOs
1.	Describe the electronic components and systems that are used in biomedical instruments and devices
2.	Explain the principle of biophysics and electrophysiology in medical devices
3.	Analyze and design circuits containing operational amplifiers and comparators using modern equipment and software
4.	Apply the acquired knowledge in recording and analyzing common electrophysiological signals
5.	Perform independent studies on new diagnostic and therapeutic treatment in biomedical applications

Teaching and Learning Activities (TLAs)

(Indicative of likely activities and tasks designed to facilitate students' achievement of the CILOs. Final details will be provided to students in their first week of attendance in this course)

CILOs 1- 4	Lectures; In-class exercises; Take-home assignments; Laboratory sessions; Individual research study on novel diagnostic or therapeutic treatment of his/her choice in a scientific format

Timetabling Information

Pattern	**Hours**
Lecture:	*39**
Laboratory:	*0*
Other activities:	*0*

**6 weeks of the lectures will be conducted in the laboratory as Laboratory sessions.*

Assessment Tasks/Activities

(Indicative of likely activities and tasks designed to assess how well the students achieve the CILOs. Final details will be provided to students in their first week of attendance in this course)

	Type of assessment tasks	***Weighting (if applicable)***
Continuous Assessment	*Quiz, Assignments, Laboratory reports, Paper and presentation on an individually assigned research topic*	*50%*
Examination	*Written exam*	*50%* 2 hours

Remarks: To pass the course, students are required to achieve at least 35% in course work and 35% in the examination. Also, 75% laboratory attendance rate must be obtained.

Grading of Student Achievement:

Letter Grade	**Grade Point**	**Grade Definitions**
A+ A A-	4.3 4.0 3.7	Excellent:
B+ B B-	3.3 3.0 2.7	Good:
C+ C C-	2.3 2.0 1.7	Adequate:
D	1.0	Marginal:
F	0.0	Failure:

Constructive Alignment with Programme Outcomes

PILO	**How the course contribute to the specific PILO(s)**
1,2	By taking this course, students will be able to describe the basic electrical characteristics of resistive and capacitive medical transducers and explain the operation of the instrumentation amplifier, and also the working principles of all currently available medical devices for diagnostic and therapeutic modulation of neural signals.
3-4	Students will be able to utilize the circuit simulation software to analyze, design and troubleshoot electronic circuits similar to those studied in class. Students will also be able to record and analyze common electrophysiological signals, including ECG and EMG etc.

5	Students will be able to identify new diagnostic and therapeutic treatment in biomedical applications through independent study
6	Students will be able to interact cooperatively and efficiently as a team member to complete laboratory exercises.

Part III

Keyword Syllabus:

Basic Analog Bioelectronics
Circuit and analog analysis; Electrical elements; Phasor analysis; Kirchhoff's voltage law (Mesh analysis); Kirchoff's current law (Nodal analysis); Frequency characteristics of circuits and analog processes; Transfer function; Bode plot; Real voltage sources (Thévenin source); Real current sources (Norton source).

Basic Concepts of Medical Instrumentation
Sensors and principles; Operational amplifiers; Instrumentation amplifiers; Signals and noise; Filters.

The Origin of Biopotentials
Electrical activity of excitable cells; Extracellular recording of action potential; Multi-unit detection; local-field potential; Electrophysiological signals include electromyogram (EMG), electrocardiogram (ECG), electroretinogram (ERG), electroencephalogram (EEG); Analysis of electrophysiological signals; Basic signal processing.

Biopotential Electrodes and Electrical Stimulation
The electrode-electrolyte interface; Irreversible Faradic reactions; Reversible Faradic reactions; Polarization of electrodes; Electrode impedance; Current pulse test; Charge delivery capacity; Calculation of electric field; Finite element model; Overview of electrode materials.

Therapeutic and Prosthetic Devices
Excitation properties of tissues; Strength-duration relationship; Sensory neural prostheses; Therapeutic devices include pacemakers, functional neuromuscular stimulators, cochlear implants, visual prostheses, and cortical prostheses.

Recommended Readings:

Semmlow J. L., "Circuits, signals, and systems for bioengineers" (Oxford Academic, 2005)
http://lib.cityu.edu.hk/record=b1877054*eng

John D. E., Susan M. B., Joseph D. B., "Introduction to biomedical engineering" (Elseiver Academic Press, c2005)
http://lib.cityu.edu.hk/record=b1887416*eng

Webster J. G., "Medical instrumentation: application and design" (John Wiley & Sons, c1998)
http://lib.cityu.edu.hk/record=b1460339*eng

Eric R. Kandel, James H. Schwartz, and Thomas M. Jessell, "Principles of Neural Science" (Appleton & Lange, c1991)
http://lib.cityu.edu.hk/record=b1217505*eng

Online Resources (if any)

Nil