City University of Hong Kong
Course Syllabus

offered by Department of Electronic Engineering
with effect from Semester B in 2017/2018

Part I Course Overview

Course Title:	Topics in Bioelectronics and Biomedical Instrumentation
Course Code:	EE5416
Course Duration:	One Semester (13 weeks)
Credit Units:	3
Level:	P5
Medium of Instruction:	English
Medium of Assessment:	English
Prerequisites: *(Course Code and Title)*	EE3110 Analog Electronic Circuits; or equivalent
Precursors: *(Course Code and Title)*	Nil
Equivalent Courses: *(Course Code and Title)*	Nil
Exclusive Courses: *(Course Code and Title)*	Nil

Part II Course Details

1. Abstract

The course aims to provide students with applied knowledge in sensory physiology including structure and function. Students will learn state-of-the-arts diagnostic and therapeutic bioelectronics devices and commonly used biomedical instrumentations.

2. Course Intended Learning Outcomes (CILOs)

(CILOs state what the student is expected to be able to do at the end of the course according to a given standard of performance.)

No.	CILOs	Weighting (if applicable)	Discovery-enriched curriculum related learning outcomes (please tick where appropriate)		
			A1	*A2*	*A3*
1.	Explain the principle of biophysics and electrophysiology in medical devices.		✓		
2.	Analyze and design circuits containing operational amplifiers and comparators using modern equipment and software.			✓	
3.	Apply the acquired knowledge in recording and analyzing common electrophysiological signals.		✓	✓	✓
4.	Perform independent studies on new diagnostic and therapeutic treatment in biomedical applications.		✓	✓	✓
		100%			

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to self-life problems.

A3: *Accomplishments*
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

3. Teaching and Learning Activities (TLAs)

(TLAs designed to facilitate students' achievement of the CILOs.)

TLA	Brief Description	CILO No.						Hours/week (if applicable)
		1	2	3	4			
Lectures	General concepts of basic analog bioelectronics, medical instrumentation, and origin of biopotentials are described. Diagnostic and therapeutic approach for medical intervention will be illustrated.	✓	✓	✓	✓			3 hrs/wk (*6 weeks of the lectures will be conducted in the laboratory as Laboratory sessions)*
Laboratory	Lab sessions with hand-on experience, for impedance measurement and recording of biopotentials, will be conducted.		✓	✓				
Case study	Individual research study on novel diagnostic OR therapeutic treatment of his/her choice in a scientific format	✓			✓			

4. Assessment Tasks/Activities (ATs)

(ATs are designed to assess how well the students achieve the CILOs.)

Assessment Tasks/Activities	CILO No.						Weighting	Remarks
	1	2	3	4	5			
Continuous Assessment: 50%								
Quizzes	✓	✓					20%	
At least 3 assignments (assignments, laboratory reports etc.)			✓	✓			30%	
Examination: 50% (duration: 2hrs)								
							100%	

Remark:

To pass the course, students are required to achieve at least 30% in course work and 30% in the examination. Also, 75% laboratory attendance rate must be obtained.

5. Assessment Rubrics

(Grading of student achievements is based on student performance in assessment tasks/activities with the following rubrics.)

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1. Examination	Achievements in CILOs	High	Significant	Moderate	Basic	Not even reaching marginal level
2. Coursework	Achievements in CILOs	High	Significant	Moderate	Basic	Not even reaching marginal level

6. 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 Other Information (more details can be provided separately in the teaching plan)

1. 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.

2. Reading List

2.1 Compulsory Readings

(Compulsory readings can include books, book chapters, or journal/magazine articles. There are also collections of e-books, e-journals available from the CityU Library.)

1.	Nil

2.2 Additional Readings

(Additional references for students to learn to expand their knowledge about the subject.)

1.	Semmlow J. L., "Circuits, signals, and systems for bioengineers" (Oxford Academic, 2005) http://lib.cityu.edu.hk/record=b1877054*eng
2.	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
3.	Webster J. G., "Medical instrumentation: application and design" (John Wiley & Sons, c1998) http://lib.cityu.edu.hk/record=b1460339*eng
4.	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