City University of Hong Kong
Course Syllabus

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

Part I Course Overview

Course Title:	Bioelectromagnetics - Theory and Topics in Engineering Applications
Course Code:	EE6616
Course Duration:	One Semester (13 weeks)
Credit Units:	3
Level:	P6
Medium of Instruction:	English
Medium of Assessment:	English
Prerequisites: *(Course Code and Title)*	Nil
Precursors: *(Course Code and Title)*	EE2104 Introduction to Electromagnetics; or equivalent.
Equivalent Courses: *(Course Code and Title)*	Nil
Exclusive Courses: *(Course Code and Title)*	Nil

Part II Course Details

1. Abstract

The aim of this course is to provide students with up-to-date knowledge on the theories, concepts in bioelectromagnetics. The course addresses selected topics in electromagnetics in human biology applications, and human safety in the field of bioelectromagnetics.

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.	Describe the fundamental theory of bioelectromagnetics in engineering.		✓		
2.	Recognise and address the issues relating to bioelectromagnetics applications in engineering.		✓	✓	
3.	Recognise the human safety aspects in the field of bioelectromagnetics.		✓	✓	
4.	Apply the principles of bioelectromagnetics in engineering analysis and in biological effects in human bodies.		✓	✓	✓
		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	Lectures on general knowledge of bio-electromagnetics theory, interaction of EM field Effect, and impacts in human body and human body.	✓	✓	✓				3 hrs/wk (*Some of the lectures will be conducted in the laboratory as case studies, demonstrations and experiments)*
Laboratory experiments	Selected experience in bio-electromagnetics applications		✓	✓	✓			
Case studies	Case study as group project		✓	✓	✓			

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				
Continuous Assessment: 50%								
At least 3 assignments (case study, group projects, assignments and laboratory experiments etc.)	✓	✓	✓	✓			50%	
Examination: 50% (duration: 2hrs , if applicable)								
							100%	

Remark:

To pass the course, students are required to achieve at least 30% in course work and 30% in the examination.

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)
1-4	Students are able to understand the principles theory in bioelectromagnetics and selected topics in the field.
2,3,4	Students are required to complete an assignment in related topics in biolectromagnetics.

Part III Other Information (more details can be provided separately in the teaching plan)

1. Keyword Syllabus

Bioelectromagnetics theory
Interaction between electromagnetic and human body, energy absorption in human body effect cell viability and DNA integrity, electromagnetic dosimetry.

Effects and impacts in human body
Source of electromagnetic fields, electro stimulation, body current and field distribution, shocks and burns, heat absorption at high frequencies, DNA change, Evaluations of SAR (Specific Absorption Rate), Human model in SARs, Cole-Cole equation, human thermoregulatory systems, bio-heat equation, impedance methods.

Interaction of EM field and human body, and biological evidence
Electromagnetic coupling into biological systems, genotoxicity and non genotoxic cellular studies, animal studies, human and epidemiological studies.

Application and human safety standards/guidelines in the field of bioelectromagnetics
Diagnosis and treatment in bioelectromagnetics applications, harmful effects, standards/guidelines at low and high frequencies, International Commission on Non Ionizing Radiation Protection Guidelines.

Laboratory in bioelectromagnetics applications
The laboratory projects are designed to complement the lecture aspects of the course, and will provide hands-on experience on selected topics in electromagnetics in human biology applications, and human safety in the field of bioelectromagnetics. Typical laboratory sessions are:

- SAR evaluations and human body model by four-pole Cole-Cole equation,
- experiment of cell viability and DNA damages
- Case studies of electromagnetics devices in biomedical applications.
- Assessment of electromagnetic interference to ICNIRP recommendations.

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.	Designated research papers in the field for case study purpose.

2.2 Additional Readings

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

1.	Basic Introduction to Bioelectromagnetics, Carl H. Durney, Douglas A. Christensen, CRC Press
2.	Handbook of Biological Effects of Electromagnetic Fields, Second Edition, Charles Polk Polk, Elliot Postow CRC Press.