

**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

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| 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: <i>(Course Code and Title)</i> | Nil |
| Precursors: <i>(Course Code and Title)</i> | EE2104 Introduction to Electromagnetics; or equivalent. |
| Equivalent Courses: <i>(Course Code and Title)</i> | Nil |
| Exclusive Courses: <i>(Course Code and Title)</i> | 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: <u>50%</u> | | | | | | | | |
| At least 3 assignments (case study, group projects, assignments and laboratory experiments etc.) | ✓ | ✓ | ✓ | ✓ | | | 50% | |
| Examination: <u>50%</u> (duration: 2hrs) | | | | | | | | |
| | | | | | | | 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 bioelectromagnetics. |

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. |
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2.2 Additional Readings

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

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|----|---|
| 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. |