City University of Hong Kong
Course Syllabus

offered by Department of Electrical Engineering
with effect from Semester A in 2020/2021

Part I Course Overview

Course Title:	Applied Electromagnetics
Course Code:	EE3109
Course Duration:	One Semester (13 weeks)
Credit Units:	3
Level:	B3
Proposed Area: *(for GE courses only)*	☐ Arts and Humanities ☐ Study of Societies, Social and Business Organisations ☐ Science and Technology
Medium of Instruction:	English
Medium of Assessment:	English
Prerequisites: *(Course Code and Title)*	EE2104 Introduction to Electromagnetics and (MA3001 Differential Equations or EE3121 Differential Equations for Electrical Engineering)
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 aim of this course is to provide students with fundamental electromagnetic theories and techniques for working as a communication engineers.

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.	Apply the Maxwell's equations to find the E-field from the H-field and vice versa			✓	
2.	Apply the boundary conditions to find the EM fields for simple problems		✓	✓	
3.	Analyze the incident and reflected waves in a transmission line			✓	
4.	Match a load to the system impedance			✓	
5.	Design a simple half wavelength dipole			✓	
		100%			

** If weighting is assigned to CILOs, they should add up to 100%.*

[#] Please specify the alignment of CILOs to the Gateway Education Programme Intended Learning outcomes (PILOs) in Section A of Annex.

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	5		
Lecture	Explain lecture notes	√	√	√	√	√		2 hrs Lect/wk
Tutorial	Problems and solutions are discussed	√	√	√	√	√		1 hr Tut/wk
Laboratory	Practical implementation and	√	√	√	√	√		

	understanding of lecture materials							3 hrs/wk (2 weeks lab)
Assignments, group discussion, self-study	Three assignments are given	√	√	√	√	√		

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 %								
Tests (min.: 2)	✓	✓	✓	✓	✓		30%	
#Assignments (min.: 3)	✓	✓	✓	✓	✓		10%	
Lab Exercises/Reports	✓	✓	✓	✓	✓		10%	
Examination: 50 % (duration: 2 hrs)								
Examination	✓	✓	✓	✓	✓		50%	
** The weightings should add up to 100%.*							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.

may include homework, tutorial exercise, project/mini-project, presentation

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 levels
2. Coursework	Achievements in CILOs	High	Significant	Moderate	Basic	Not even reaching marginal levels

6. Constructive Alignment with Major Outcomes

MILO	How the course contribute to the specific MILO(s)
1, 5	Mathematics, science, and engineering techniques are used extensively in this course.
2, 4, 7, 10	There are two laboratory sessions for students to practice theories related to the course as well as engineering tools in their analysis. The communication skills of the students will be trained in writing their reports.

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

1. Keyword Syllabus

Electromagnetic Wave Propagation
Revision of time harmonic analysis; Gauss', Ampere's, and Faraday's laws. Conduction and dielectric losses, loss tangent. Displacement current and Maxwell's equations. Plane wave propagation in a homogeneous medium, propagation constant, intrinsic impedance. Wave polarization, circularly polarized waves, axial ratio.

Reflection, Refraction, and Transmission
Boundary conditions. Wave reflection, refraction, and transmission at a dielectric-dielectric interface, Snell's Law. Phase and group velocities, standing waves, total internal reflection. Multiple reflections, quarter-wave coating. Reflection of polarized waves, Brewster angle. Wave reflection from a plane of conductor.

Transmission Lines
Wave propagation in a terminated transmission line, phase velocity, attenuation constant. Circuit parameters of typical transmission lines. Characteristic impedance, reflection coefficient, voltage standing ratio. Power transfer, impedance matching, Smith chart. Multiple reflections, quarter-wave transformer. Dielectric waveguide.

Radiation
Fresnel and Fraunhofer zones, radiation conditions. Radiation of a tiny current element, a half wavelength dipole, and a patch antenna. Radiation pattern, radiation resistance, beamwidth, bandwidth, gain, and directivity. Power transfer, effective isotropic radiation power, antenna aperture, Friss transmission formula.

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.	F. T. Ulaby and U. Ravaioli: Fundamentals of Applied Electromagnetics (Pearson, 7th Ed., 2015)

2.2 Additional Readings

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

1.	Ida, Nathan: Engineering Electromagnetics (Springer, 3rd Ed., 2015)
2.	W Hayt and J Buck: Engineering Electromagnetics, (McGraw Hill, 8th Edition, New York, 2010)
3.	S. J. Orfanidis: Electromagnetic Waves and Antennas (2008) (Available online: www.ece.rutgers.edu/~orfanidi/ewa)