City University of Hong Kong
Course Syllabus

offered by Department of Electrical Engineering
with effect from Semester A in 2024/2025

Part I Course Overview

Course Title:	Electromagnetic Compatibility - EMC Theory, Design and Measurement
Course Code:	EE6449
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 EE3109 Applied Electromagnetics; or equivalent; or Courses in Electromagnetics, Applied Electromagnetics.
Equivalent Courses: *(Course Code and Title)*	Nil
Exclusive Courses: *(Course Code and Title)*	Nil

Part II Course Details

1. Abstract

This course aims to provide students with fundamental knowledge in three areas of Electromagnetic Compatibility (EMC):

- EMC Standards and Regulations
- Tests and measurements
- EMC diagnostic and design techniques

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 general concepts of EMC Standards and Regulations.				
2.	Recognize the latest major EMC Tests and measurement techniques in EMC Test Laboratory.		✓	✓	
3.	Apply the general EMC diagnostic and design approaches and techniques for different 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 real-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. Learning and Teaching Activities (LTAs)

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

LTA	Brief Description	CILO No.						Hours/week (if applicable)
		1	2	3				
Lecture	Students will gain an understanding of fundamental concepts in EMC Standards and Regulations, as well as techniques for EMC tests and measurements.	✓						3 hrs/wk for 6 weeks
Laboratory	Students will gain hands-on experience with the latest EMC tests and measurement techniques in an EMC Test Laboratory during the lab sessions.	✓	✓					3 hrs/wk for 5 weeks
Case study	Students will engage in small group case studies focusing on selected EMC topics related to EMC design and diagnostic techniques.		✓	✓				3 hrs/wk for 2 weeks

Discovery Learning Experience (DLE) is also a key to this course - with tasks assigned via the case studies of this course, and supported with discussion with students to assess their progress, students are feed-backed on their quality of their case studies for progression.

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					
Continuous Assessment: 60%								
Quiz I & II	✓						20%	
Laboratory logbook	✓	✓					5%	
Formal report		✓	✓				10%	
EMC Case study		✓	✓				5%	
Examination: 40% (duration: 2hrs, if applicable)								
Examination	✓	✓	✓				60%	
							100%	

Remark:

To successfully pass the course, students must attain a minimum of 30% in coursework, 30% in the examination, and achieve a laboratory attendance rate of at least 75%.

5. Assessment Rubrics

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

Applicable to students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter

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

Applicable to students admitted from Semester A 2022/23 to Summer Term 2024

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

6. Constructive Alignment with Programme Outcomes

PILO	How the course contribute to the specific PILO(s)
1, 2, 3, 4, 5	This course aims to provide students with knowledge in three major areas of Electromagnetic Compatibility (EMC). Upon completion of this course, students will gain general knowledge of CE Marking procedures for launching electronic products in the open market.
2, 3, 4, 5	Students are required to complete an assignment designed to gain practical hands-on experience on how EMC measurements are carried out in test houses, and some practical methods for RFI suppression and EMS improvement when measurements exceed EMC limits.

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

1. Keyword Syllabus

Fundamentals
Introduction to Electromagnetic Interference, Conducted and Radiated Emission, Conducted and Radiated Susceptibility, Product slippage.

EMC standards and Regulations for export to Europe and USA
European Community Directive on EMC and relevant Standards, Directive 2004/108/EC, Generic Standards & Product Standards, FCC regulations & other specifications.

Achieving Compliance for your products and problems encountered
Routes to compliance, Large System & Fixed Installations.

EMC Theory
Electromagnetic field propagation, skin effects, electric and magnetic dipole, near field and far field radiation, capacitive and inductive coupling, Rayleigh range of antennas, common-mode and differential-mode emission, ESD coupling.

EMC Measurement and test facilities
ESD (Electrostatic Discharge) test, conducted emission test, conductive immunity test, radiated emission test, radiated immunity test, Harmonic and voltage fluctuations, EMC in large systems, Open Field Test Sites, Normalized Site Attenuation, Screened rooms and anechoic chambers, Antenna for EMC measurement.

Diagnostic testing and EMC design
E and H field Shielding, Screening effectiveness, cross talk, common impedance, PCB layout, switching noise, coupling of external field to cable, snubber location and design, component placement and mounting, ESD considerations on power supplies.

Laboratory:
The laboratory projects are designed to complement the lecture aspects of the course, and will provide hands-on experience on how various measurements and methods defined in the Euro Norm are carried out.

Typical laboratory/case study sessions are:

- Radiated Emission measurement of a telephone answering machine for EN55022
- Radiated Susceptibility measurement of an electronic product for EN61000-4-3
- Conducted Emission measurement of a good PCB layout and a poor PCB layout
- E-field and H-field Close-Field Probe diagnostic measurement

- Coupled lines - grounding effect noise reduction of coupling between PCB tracks
- Measurement of common impedance interference on various PCB layouts
- Harmonics and Flicker Measurement - To measure the harmonics and voltage fluctuations (flicker) caused by mains operated equipment
- ESD –Electrostatic Discharge measurement of a pager for EN61000-4-2
- Filter selection for EMI suppression.

Teaching Methods:
Teaching will be conducted in 3-hour sessions, which are in the form of combined lecture and class discussions of various EMC topics. The laboratory support shall consist of about six 3-hour sessions on topics mentioned above.

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.	EMC standards for limits and methods of measurement, EMC Directives .(E- resources available from the CityU Library)
2.	Clayton R. Paul, Robert C Scully, and mark A. Steffka, Introduction to Electromagnetic Compatibility, 3rd edition, Wiley.

2.2 Additional Readings

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

1.	S W Leung: Notes on Electromagnetic Compatibility (EMC) Workshops and training courses, on Design, Testing and Theory, IEEE Symposium Records: IEEE International Symposium on Electromagnetic Compatibility.
2.	S W Leung: EMC short course notes.