EE6449: ELECTROMAGNETIC COMPATIBILITY - EMC THEORY, DESIGN AND MEASUREMENT

Effective Term
Semester B 2024/25

Part I Course Overview

Course Title
Electromagnetic Compatibility - EMC Theory, Design and Measurement

Subject Code
EE - Electrical Engineering
Course Number
6449

Academic Unit
Electrical Engineering (EE)

College/School
College of Engineering (EG)

Course Duration
One Semester

Credit Units
3

Level
P5, P6 - Postgraduate Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
Nil

Precursors
EE2104 Introduction to Electromagnetics; or EE3109 Applied Electromagnetics; or equivalent; or Courses in Electromagnetics, Applied Electromagnetics.

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

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

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-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.		x	x	
3	Apply the general EMC diagnostic and design approaches and techniques for different applications.		x	x	x

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.

Learning and Teaching Activities (LTAs)

	LTAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lecture	Students will gain an understanding of fundamental concepts in EMC Standards and Regulations, as well as techniques for EMC tests and measurements.	1	3 hrs/wk for 6 weeks
2	Laboratory	Students will gain hands-on experience with the latest EMC tests and measurement techniques in an EMC Test Laboratory during the lab sessions.	1, 2	3 hrs/wk for 5 weeks

3	Case study	Students will engage in small group case studies focusing on selected EMC topics related to EMC design and diagnostic techniques.	2, 3	3 hrs/wk for 2 weeks

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Quiz I & II	1	20	
2	Laboratory logbook	1, 2	5	
3	Formal report	2, 3	10	
4	EMC Case study	2, 3	5	

Continuous Assessment (%)

40

Examination (%)

60

Examination Duration (Hours)

2

Additional Information for ATs

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%.

Assessment Rubrics (AR)

Assessment Task

Examination (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

Achievements in CILOs

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal

(D) Basic

Failure

(F) Not even reaching marginal level

Assessment Task

Coursework (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion
Achievements in CILOs

Excellent
(A+, A, A-) High

Good
(B+, B, B-) Significant

Fair
(C+, C, C-) Moderate

Marginal
(D) Basic

Failure
(F) Not even reaching marginal level

Assessment Task
Examination (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Achievements in CILOs

Excellent
(A+, A, A-) High

Good
(B+, B) Medium

Marginal
(B-, C+, C) Low

Failure
(F) Not even reaching marginal level

Assessment Task
Coursework (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Achievements in CILOs

Excellent
(A+, A, A-) High

Good
(B+, B) Medium

Marginal
(B-, C+, C) Low

Failure

(F) Not even reaching marginal level

Additional Information for AR

Constructive Alignment with Programme Outcomes

PILO 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.

PILO 2, 3, 4, 5 Students are required to complete an assignment designed to gain practical handson 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

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.

Reading List

Compulsory Readings

	Title
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.

Additional Readings

	Title
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.