City University of Hong Kong

Information on a Course offered by Department of Electronic Engineering with effect from Semester A 2013/14

Part I

Course Title:	Applied Electromagnetics in Electronic Design
Course Code:	EE5604
Course Duration:	One Semester (13 weeks)
No. of credits:	3
Level:	P5
Medium of Instruction:	English
Prerequisites*:*	EE2104 Introduction to Electromagnetics or EE3109 Applied Electromagnetics or equivalent
Precursors:	
Equivalent Course:	Nil
Exclusive Courses:	Nil

Part II

Course Aims:

The course aims to provide students with an understanding of the principles of *electromagnetic field theory,* with emphasis on some basic problem-solving techniques via discovery learning, leading to the solutions of more advance and practical electromagnetic problems in circuit or product design, commonly faced by electronic engineers in the industry.

Course Intended Learning Outcomes (CILOs)
Upon successful completion of this course, students should be able to:

No.	CILOs
1.	Apply the Maxwell's equations in solving quasi-static electromagnetic problems.
2.	Understand the Maxwell's equations, and the on-the-market EM field computation softwares.
3.	Apply EM field theories in solving some practical classical problems.
4.	Apply practical techniques for solving some industrial EM problems.

Teaching and learning Activities (TLAs)

(Indicative of likely activities and tasks designed to facilitate students' achievement of the CILOs. Final details will be provided to students in their first week of attendance in this course)

CILO	Teaching and Learning Activities
1, 2, 3, 4	Lecture, tutorial, in-class exercise, self-study, case study and laboratory sessions.

The teaching method of this course is Problem-based Learning in which students learn about the approach to some EM solutions in the context of complex, multifaceted, and realistic problems. Discovery Learning Experience (DLE) is also a key to this course - with tasks assigned via the case studies of this course, and supported with regular meetings with students to assess their progress, and roadblock; students are feed-backed on their quality of their case studies for progression,

Timetabling Information

Pattern	Hours
Lecture:	39
Tutorials:	
Laboratory:	
Other activities:	

*Some of the lecturers will be conducted in the laboratory.

Assessment Tasks/Activities

(Indicative of likely activities and tasks designed to assess how well the students achieve the CILOs. Final details will be provided to students in their first week of attendance in this course)

	Type of assessment tasks	*Weighting (if applicable)*
Continuous Assessment	Assignments, test, lab work and lab report	100%

Remarks: To pass the course, students are required to obtain at least 40% of the coursework marks and a laboratory attendance of at least 75%.

Grading of Student Achievement:

Letter Grade	Grade Point	Grade Definitions
A+ A A-	4.3 4.0 3.7	Excellent
B+ B B-	3.3 3.0 2.7	Good
C+ C C-	2.3 2.0 1.7	Adequate
D	1.0	Marginal
F	0.0	Failure

Constructive Alignment with Programme Outcomes

PILO	How the course contribute to the specific PILO(s)
1,2,3,4	The application of EM field to engineering problems is central to the aim of this course. Students are encouraged to develop the ability to integrate their learning into a real-world design in Applied Electromagnetics.
2,3,4,5	Students are required to complete an assignment/case study designed to gain practical hands-on experience and to reflect what they have learned on how computational electromagnetic field in some practical problems, including analytical approach using Maxwell's Equations and Wave equations, to the use of more advance commercial available EM simulation tools such as IE3D, Fidelity, and HFSS.

Part III

Keyword Syllabus:

Fundamental of Electromagnetic Field (5 weeks)
Revision and applications of Coulomb's law. Gauss's law. Ampere's law. Biot-Savart law. Maxwell's Equations. Wave propagation, Boundary conditions and equations,.

Field evaluation of Static Electric field, Static Magnetic Field, and Quasi-Static Electromagnetic Field, Time varying Electromagnetic Field.

Common EM problems in electronic design industry. (2 weeks)
Mutual coupling in traces of PCBs, Radiation problem in PCB, Numerical methods and tools for solving Electromagnetic Field problems (3 weeks)

Method of Moment, Finite-different method, Finite-Different-Time Domain Method, Finite-element method, Introduction to software IE3D, Fidelity, and HFSS.

EM techniques in solving industry EM problems (3 weeks)
Grounding, filtering, shielding, impendence matching, and coupling in traces of PCB.

Related Links and References

- Department of Electronic Engineering
- http://www.mentor.com/electromagnetic-simulation/
- **"Fundamentals of Applied Electromagnetics"** by Fawwaz Ulaby, Prentice Hall
- **"Electromagnetics"** by John Kraus, McGraw Hill.

Examples of Case Studies :

Students are assigned with case studies for creating their owned EM models, using either analytical approaches or advance commercial available EM simulation tools in solving some practical problems in:

1. L,R,C of traces of PCB –circuit modeling, using simple circuit equations for PCB design purpose.
2. Mutual capacitance and mutual inductance of traces of PCB –circuit modeling, using simple circuit equations for cross talk, and cross coupling of digital PCB design purpose.
3. Comparison of analytical outcomes with Empirical equations, e.g. 3W rules, 10H rules of PCB designs.
4. Shielding effectiveness of various materials using wave propagation equations.
5. Calculation of shielding effectiveness, of casing with aperture using simple numerical approach driving from *Possions*' Equations.

6. Shielding effectiveness of electronic equipment casing with apertures, using commercial numerical soft ware.
7. Shielding effectiveness ferrite magnetic materials in for magnetic field interferences at power frequency.
8. Electric and/or magnetic emission of simple geometry using Maxwell's Equations.
9. Emission characteristics of equipment commercial available numerical software to more complex geometry.
10. Radiation patterns using commercial available numerical software to more complex geometries.
11. Component design in RF circuitry, including inductors and filters in GHzs