Electromagnetic Compatibility/Interference (EMC/I) (3+0)

Course Code: EE-845

Course Description:

EMC is concerned with the Generation, Transmission, and Reception of Electromagnetic Energy. These three aspects of EMC problem form the basic framework of any EMC design. The subject of EMC is as important sub -discipline of electrical engineering (EE) as other more traditional subjects such as electric circuit analysis and electronics. The prerequisites are the completion of the basic undergraduate electrical engineering courses in electric circuit analysis, signals and systems, electronics, and electromagnetic fields. This course builds on those basic skills, principles, and concepts and applies them to the design of modern electronic systems so that these systems will operate compatibly with other electronic systems and also comply with various governmental regulations on radiated and conducted electromagnetic emissions. In essence, EMC deals with interference and the prevention of it through a compatible design of electronic systems.

This course is also concerned with the design of electronic systems such that interference from or to that system will be minimized. The emphasis will be on digital electronic systems. An electronic system that is able to function compatibly with other electronic systems and not produce or be susceptible to interference is said to be electromagnetically compatible with its environment. A system is electromagnetically compatible with its environment if it satisfies three criteria:

1. It does not cause interference with other systems.
2. It is not susceptible to emissions from other systems.
3. It does not cause interference with itself.

Designing for EMC is not only important for the desired functional performance; the device must also meet legal requirements in virtually all countries of the world before it can be sold. Designing an electronic product to perform a new and exciting function is a waste of effort if it cannot be placed on the market! EMC design techniques and methodology have become as integral part of a design as, for example, digital design.

Consequently the material in this course has become a fundamental part of an electrical engineer's background.

Text Book:

Introduction to Electromagnetic Compatibility by Clayton Paul, 2nd Ed, 2006

Reference Books:

- Designing Electronic Systems for EMC, William G. Duff, 2011
- Electromagnetic Compatibility Engineering by Henry Ott. 2009
- EMC for Product Designers by T. Williams, 3rd Ed. 2001

Pre-requisites: NA

ASSESSMENT SYSTEM

Quizzes	10%
Assignments	10%
MSE	30%
Projects	10%
ESE	40%

Teaching Plan:

Week No.	Topics	Learning outcomes
1-2	**Electromagnetic Compatibility (EMC**)	Aspects of EMC History of EMC Examples Electrical Dimensions and Waves Decibels and Common EMC units Power loss in cables Signal Sources Specification
3-4	**EMC Requirement for Electronic Systems**	Requirements for Commercial Product Marketed in USA Requirements for Commercial Product Marketed outside USA Requirements for Commercial Aircrafts Requirements for Commercial Vehicles Design Constraints for Products
5-6	**Transmission Lines and Signal Integrity**	Transmission Line Equation Per-Unit-Length Parameters for wire and PCB structures High Speed digital interconnects and signal integrity Different Solutions (Time domain, Lumped circuit model, phasor solution)
7-8	**Signal Spectra- The relationship between Time domain and Frequency Domain**	Periodic Signals & Multiple Harmonics Spectra of Digital Waveforms
	MIDTERM IN WEEK 9	
10	**Different Types of EMI Coupling**	Electric Field or capacitive coupling Magnetic Field or inductive coupling Plane wave coupling Common Impedance Problem Coupling in PCB circuits

11-12	**Conducted Emissions and Susceptibility**	Measurement of Conducted Emissions Power Supply Filters Power Supplies Power Supply and Filter Placement Conducted Susceptibility
13	**Antennas**	Wire Antennas. Aperture Antennas Wideband Antennas Antenna Gain factor
14-15	**Radiated Emissions and Susceptibility**	Simple Emission Models for wires and PCB lands Simple Susceptibility Models for wires and PCB lands
16	**Crosstalk**	Two Conductor TLs and Cross-Talk Three Conductor TLs and Cross-Talk
17	**Shielding**	Shielding Effectiveness SE against Far-Field Sources
		SE against Near-Field Sources ***System Design for EMC**
18	**END SEMESTER EXAMS**	