Course Code	Course Title	L	T	P	C
1152EC221	ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY	2	0	2	3

a) Course Category

Program elective

b) Preamble

This course provides basic information on the different electromagnetic Interference problems occurring in Intersystem, their possible mitigation techniques in Electronic design, also to understand EMI sources, EMI problems, their solutions at PCB level, as well as to understand sub system level design and to measure the emission, immunity level from different systems to couple with the prescribed EMC standards.

c) Prerequisite

Electromagnetic Fields

d) Related Courses

Waveguides& Antennas

e) Course educational objectives

Introduce the concepts of electromagnetic interference and electromagnetic interference compatibility

Study the electromagnetic interferencecoupling principles

Study the electromagnetic interference control techniques

Learn electromagnetic compatibility design of PCBS

Discuss electromagnetic interference measurements and standards

f) Course Outcomes

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Describe the concept of EMI / EMC related to product design & development.	K2
CO2	Analyze the different EM coupling principles and its impact on performance of electronic system.	K3
CO3	Analyze the electromagnetic interference, highlighting the	K3

	concepts of both susceptibility and immunity.	
CO4	Analyze various EM compatibility issues with regard to the design of PCBs and ways to improve the overall system performance.	K3
CO5	Describe various EM radiation measurement techniques and the present leading edge industry standards in different countries	K2

g)	**Correlation of COs with POs**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	H	H	M	L	L	-	-	L	-	-	-	L	-	-
CO2	H	H	M	-	-	-	-	-	-	-	-	-	-	-
CO3	-	H	-	-	M	-	-	-	-	-	-	-	L	-
CO4	M	H	-	-	L	-	-	-	-	-	-	-	L	-
CO5	M	-	-	L	L	L	-	-	-	L	L	-	L	-

h) Course Content

UNIT I EMI/EMC CONCEPTS 9

EMI-EMC definitions and Units of Parameters; Sources and Victim of EMI; Conducted and Radiated EMI Emission and Susceptibility; Transient EMI, ESD; Radiation Hazards.

UNIT II EMI COUPLING PRINCIPLES 9

Conducted, Radiated and Transient coupling; Common ground impedance coupling; Common mode and Ground loop coupling; Differential mode coupling; Near field cable to Cable coupling, Cross talk; Field to Cable coupling; Power mains and Power supply coupling.

UNIT III EMI CONTROL TECHNIQUES 9

Shielding Material- Characteristics of Filters-Impedance and Lumped element filters-Filter installation and Evaluation; Grounding, Bonding, Isolation transformer, Transient suppressors, EMC Gaskets.

UNIT IV EMC DESIGN OF PCBS 9

EMI Suppression Cables-Devices-Transient protection hybrid circuits; PCB Trace impedance; Routing; - Electromagnetic Pulse-Noise from Relays and Switches, Power distribution decoupling; Zoning; Grounding

UNIT V EMI MEASUREMENTS AND STANDARDS 9

Open area test site; TEM cell; EMI Test Shielded chamber and Shielded Ferrite Lined anechoic chamber; Tx /Rx Antennas, Sensors, Injectors / Couplers, and Coupling factors; EMI Rx and Spectrum analyzer; Civilian Standards-CISPR, FCC, IEC, EN; Military Standards –Frequency Allocation and Spectrum Utilization -

Comparisons.

List of experiments

S. No	Practical Exercises (15 Hours)	COs
1.	Concept of Self-Induction Board	CO1
2.	Concept of Lenz Law	CO1
3.	EMI effects on Co-axial Cable	CO2,CO3
4.	Concept of Cross Talk Basic Phenomena	CO2,CO4
5.	EMI effects on Cross Talk problem	CO2,CO4
6.	EMI effects on Inductance and Capacitance with various VIAs and	CO4
7.	EMI effects on Inductance and Capacitance with Radial and SMD components	CO4
8.	EMI effects on Ground Bounce for Symmetric IC Power Pins	CO4
9.	EMI effects on Ground Bounce with Difference Between Symmetric and Asymmetric IC Power Pins	CO4

Total 60 Hours

i) Learning Resources

Text Books

1. V.P.Kodali,"EngineeringEMCPrinciples,MeasurementsandTechnologies",IEEEPress,Newyork, 1996.
2. HenryW.Ott.,"NoiseReductionTechniquesinElectronicSystems",AWileyInter SciencePublications,JohnWileyandSons,Newyork,1988.

Reference Books

1. BemhardKeiser,"PrinciplesofElectromagneticCompatibility",3rdEd,Artechhouse,Norwood,1986
2. C.R.Paul, "Introduction to ElectromagneticCompatibility",JohnWileyandSons,Inc, 1992.

Online Resources

1. http://www.metlabs.com/blog/emc/electromagnetic-compatibility-compliance-engineers-use-these-emc-resources/
2. http://www.intertek.com/emc/