ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY (EMI/EMC)

(Elective-II)

Course Code: 15EE2215

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Pre requisites: Electric circuits, Networks, Power Electronics and Power Systems.

Course Outcomes: At the end of the course, the students will have knowledge in

CO1: EMI Environment, Coupling principles, Different sources of EMI and Mitigation Techniques.

CO2: Measurement Techniques for Conducted Interference and the effect of power supply components on Conducted Emissions.

CO3: Grounding, Cabling, Shielding, Bonding mechanisms for EMC.

CO4: Various EMI filters and the EMI/EMC Standards.

UNIT-I (10-Lectures)

INTRODUCTION:

Introduction to EMI and EMC, Sources of EMI, Conducted and Radiated EMI emission and susceptibility, Radiation hazards to humans, EMC Testing categories, Practical experiences and concerns, frequency spectrum conservations, Mechanisms of EMI generation, EMI Testing and Measurement, Methods of mitigation of EMI and Biological effects of EMI.

UNIT-II (10-Lectures)

EMI FROM APPARATUS / CIRCUITS:

Introduction**,** Electromagnetic Emissions, Noise from relays and Switches, Nonlinearities in Circuits, Passive Inter modulation, Cross-Talk in Transmission lines, Transients in Power Supply Lines-calculation of induced Voltages and Currents, Surges on Mains Power Supply, EMI- Radiation coupling, Conduction coupling, Combination of

both Radiation and Conduction coupling.

UNIT-III (10-Lectures)

CONDUCTED INTERFERENCE MEASUREMENTS:

Introduction, Characterization of Currents / Voltages, Common-Mode and Differential-Mode Interferences-examples, Conducted EM Noise on Power Supply Lines-Transients on power Supply Lines, Propagation of surges in Low Voltage AC lines, Conducted EMI from equipment and Apparatus-Instrumentation for Measuring the Conducted EMI, Experimental setup, Measurement of CM and DM Interferences, Immunity to Conducted EMI.

Power Supplies - Linear Power Supplies - Switched-Mode Power Supplies (SMPS)- Effect of Power Supply Components on Conducted Emissions- Power Supply and Filter Placement-Conducted Susceptibility

UNIT-IV (10-Lectures)

GROUNDING, CABLING, SHIELDING AND BONDING:

Safety and signal grounds, low and high frequency grounding methods, grounding of amplifiers and cable shields, isolation, neutralizing transformers, shield grounding at high frequencies, digital grounding.

Types of cables, Mechanism of EMI emission / Coupling in cables.

Shielding Effectiveness, near and far fields / impedances sources, methods of analysis, total loss due to absorption and reflection effects, composite absorption and reflection losses for electric fields / magnetic fields, Low frequency magnetic shielding, Effect of Apertures.

Electrical Bonding, Shape and Material for Bond straps, General Characteristics of good bonds.

UNIT-V (10-Lectures)

EMI FILTERS AND EMI/EMC STANDARDS:

Introduction, Characteristics of various filters – Impedance Mismatch Effects-Lumped Element Low-Pass Filters, High-Pass Filters, Band-Pass Filters, Band-reject Filters, Power Line Filter design-Common-Mode Filter, Differential-Mode filter, Combined CM and DM filter.

Components for EMC and EMC Standards - Choice of capacitors, inductors, transformers and resistors, EMC design components, National / International EMC standards, military and civilian standards.

TEXT BOOKS:

1. Engineering Electromagnetic Compatibility by Dr. V.P. Kodali, IEEE Publication, Printed in India by S. Chand & Co. Ltd., New Delhi, 2000.
2. Henry W. Ott, Electromagnetic Compatibility Engineering, John Wiley & Sons Inc, New York, 2009
3. Clayton R.Paul, Introduction to electromagnetic compatibility, John Wiley and Sons, Inc. 1991.

REFERENCE BOOKS:

1. Daryl Gerke and William Kimmel, "EDN‟s Designer's Guide to Electromagnetic Compatibility", Elsevier Science & Technology Books, 2002.
2. Dr Kenneth L Kaiser, "The Electromagnetic Compatibility Handbook", CRC Press 2005.
3. Bernhard Keiser, "Principles of Electromagnetic Compatibility", 3rd Edition, Artech house, 1986.