BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, Pilani
Pilani Campus
AUGS/ AGSR Division

SECOND SEMESTER 2020-21
COURSE HANDOUT

Date: 31.12.2020

In addition to part I (General Handout for all courses appended to the Time table) this portion gives further specific details regarding the course.

Course No : **EEE F436**
Course Title : **Electromagnetic Compatibility**
Instructor-in-Charge : **Dr. Praveen Kumar A.V.**
Instructor(s) : **None**
Tutorial/Practical Instructors: None

1. Course Description: Basic concepts of EMI/EMC – sources, units, coupling, issues and regulation, Electrical signals and spectral properties, Time and frequency relations, Measurement, Behavior of electrical circuits, Self and mutual impedances, Transmission lines and signal integrity, Non-ideal behavior of wires and lumped components, Emission and Susceptibility –conducted and radiated, Emission models – common mode and differential, Measurement of emissions, System design for EMI, High speed circuit boards, Electrostatic discharge, Cross-talk, Three conductor transmission lines, Grounding, Shielding, Cabling, Filtering, Decoupling, Other EMI related issues.

2. Scope and Objective of the Course: Electromagnetic compatibility (EMC) is the engineering of electrical systems to ensure the overall functioning in a complex electromagnetic environment. With the advancements in high speed communication, switching techniques, and integrated circuit technologies, devices affect one another through the phenomenon called the electromagnetic interference (EMI). A system that is designed for EMC doesn't interfere with the operation of other systems, is immune from the emissions of other systems and doesn't interfere with its own operation. An electronic product that is not compliant with the respective EMC standards doesn't qualify to be marketed. It is recommended to take the EMC into account starting from the design stage of a system, as discovering it at a later stage, especially during the products' compliance testing will cost both time and money. The course which is industry relevant, addresses the issues, reasons, regulatory obligations, and solutions to EMC issues faced by electrical systems. A good knowledge of undergraduate level electromagnetic theory and circuit analysis are required to fully appreciate the course.

3. Text Books: Paul, C.R., "Introduction to Electromagnetic Compatibility", 2nd ed., Wiley (2010)

4. Reference Books:

R1. David K. Cheng, "Field and Wave Electromagnetics", 2nd ed. Pearson Education, 2009

R2. Course notes on Electromagnetic compatibility, Michigan State University. Available online at: https://www.egr.msu.edu/emrg/electromagnetic-compatibility-emc-course-notes

5. Course Plan:

Module No.	Lecture Session	Reference	Learning outcomes (Topics)
1	**1-4: Introduction to EMI/EMC and its components**	Ch.1-2 (TB), Supplementary material	EMI sources – external/ internal, unintentional / intentional, EMC, Aspects, decomposition of EMC problem, History, Typical scenarios, Regulations (brief), EMC in product

			design – compliance vs pre-compliance testing
2	**5-9: Theoretical foundation of EMI/EMC**	Ch.2, Ch.3 Ch.4(TB), R2 Appendix A-B, (TB), R1	Electrical dimensions, Units of EMC, Review of Maxwell's equations, TEM mode, Transmission lines and signal integrity (concept), PCB lands and microstrip line, Electrical length and line delay, Signals and spectral content, Digital waveforms, Trapezoidal signals – characteristics
3	**10-14 : Non-ideal behavior of Components**	Ch.5(TB), R2	Wires – resistance and internal inductance, External inductance and capacitance, Lumped equivalent circuit of parallel wires, PCB lands, Effect of component leads, Non-deal models of Resistor, Capacitor and Inductor, Use of R, C and L in EMI reduction – tradeoffs
4	**15-22 : Emission and susceptibility**	Ch. 6 & 8, ch. 7 (brief), R2	Emissions / susceptibility - Conducted / radiated, Simple emission models, differential and common mode currents, Measurement of EMI
5	**23-30 : Coupling and cross-talk**	Ch. 9-10 (TB),R2	Near-field and far-field coupling, Cross-talk – Capacitive coupling, Inductive coupling, LC coupling, Common impedance coupling, Coupling to shielded cables, Electromagnetic coupling

6	**31-40: Solutions to EMI/EMC problems**	Ch.11 (TB), R2	Grounding, Cable shielding, Electromagnetic shielding, Filtering, Surge protection, Decoupling, Lightning protection, Printed circuit boards – design considerations, EMC simulators

6. Evaluation Scheme:

Component	Duration	Weightage (%)	Date & Time	Nature of component (Close Book/ Open Book)
Mid-Semester Test	90 Min.	30	TBA	Open and /or Close book
Comprehensive Examination	2 Hrs.	30	13/05 FN	Open and /or Close book
Quiz	15-20 Min.	30	Announced and/or Surprise	Close book
Assignment	NA	10	TBA	Open book

7. Chamber Consultation Hour: TBA

8. Notices: Will be displayed only in *Nalanda*

9. Make-up Policy: Make-up will be allowed only in genuine cases, according to the latest institutional policies.

10. Note (if any): TBA

Instructor-in-charge
Course No. EEE F436