Course Type	Course Code	Name of the Course	L	T	P	Credits
DC	NEEC510	Electromagnetic Compatibility of Power Converters	3	1	0	4

Course Objective

- This course covers fundamental and advanced design concepts related to the design of power electronic circuits for meeting electromagnetic compatibility requirements.

Learning Outcomes

Upon the completion of the course, students will:

- Understand electromagnetic compatibility requirements that a power converter must adhere
- Understand the various sources of electromagnetic interference emissions
- Know various methods to reduce the EMI emissions
- Understand the filter design basics for minimising EMI emissions
- Be able to implement design rules to counter EMI problems

Unit No.	Topics to be Covered	Lecture + Tutorial Hours	Learning Outcome
1	Introduction to Electromagnetic Compatibility (EMC), Noise, Interference, Electromagnetic Interference (EMI), Radiated and Conducted EMI, Electromagnetic Susceptibility (Immunity), Radiated and Conducted Susceptibility (Immunity), Types of coupling, Differential and Common Mode Noise Emissions, Electromagnetic Susceptibility Tests, EMC regulations	4L+1T	Students will learn the basics of EMC and various associated terms.
2	Overview of Power Electronic Circuit Topologies, Generation of EMI in front-end isolated and non-isolated DC-DC converters, Generation of EMI in Grid-Tied converters, EMI in EVs, EMI problems of Motor Drive systems, Wireless Charging systems, Vehicle Controller, Battery Management Systems.	9L+3T	Students will learn about the generation of EMI in power converters and EVs and the problems caused by it.
3	Crosstalk and Electromagnetic Coupling Between PCB Tracks, Wires, and Cables, Noise penetration at high switching frequency (using fast semiconductor devices).	5L+2T	Students will understand the problems related to PCB design and issues while operating converters at a high switching frequency.
4	EMI measurement, Introduction to Line impedance stabilisation network (LISN) and its working principle. Types of LISN, EMI predictions, Measurement units and detection methods, Software for EMI prediction, Various architectures of EMI measurement, and Spectrum analysers.	7L+2T	Students will develop a basic theory about the measurement and prediction of EMI from power electronic circuits.
5	Methods to reduce radiated emissions, PCB Layout to Reduce Unwanted Coupling, Identifying Unintentional "Antennas", Grounding Strategies for Power Circuits, EM Shielding for Power Electronics, and Ferrite Beads.	6L+2T	Students will learn about PCB design techniques and strategies to reduce radiated emissions.
6	Input and Grid-side (in grid-connected converters) filter design, Common mode and differential mode filter design, Middlebrook stability criterion, X & Y Capacitors, Inductors and CM Chokes.	9L+3T	Students will learn filter design steps to counter EMI emissions
7	A design case study.	2L+1T	Students will follow all the rules and design a power electronic converter with the aim of minimising EMI emissions.
	Total Contact Hours	**42L+14T**	

Textbook:

1. Robert W. Erickson, Dragan Maksimovic, *Fundamentals of Power Electronics, Third Edition*, Springer Cham, 2020.
2. William G. Duff, *Designing Electronic Systems for EMC*, SciTech Publishing Inc, 2011.

Reference Books:

1. Li Zhai, *Electromagnetic Compatibility of Electric Vehicle*. Springer, 2021.
2. François Costa, et al. *Electromagnetic Compatibility in Power Electronics,* Wiley, 2014.
3. Clayton R. Paul. *Introduction to Electromagnetic Compatibility, Second Edition,* John Wiley & Sons, Inc. Publication, 2006.
4. **Optional Software:** PLECS