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

SECOND SEMESTER 2020-21
COURSE HANDOUT

Date: 04.01.2021

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/INSTR F342
Course Title : Power Electronics
Instructor-in-Charge : *Rajneesh Kumar*
Instructor(s) : Ashish Patel, Dheerendra Singh, H D Mathur, Aditya R Gautam

1. Course Description: This course covers basic power electronic circuits which includes DC-DC converters, Rectifiers and Inverters. Steady state analysis of these converters is discussed in details with emphasis on proper selection of devices and magnetic components. Mathematical modeling of converter transfer function using various approaches is also included for controller design of these converters. Experiments are designed to understand the working of these power electronic circuits supported with MATLAB/SIMULINK based simulation platform.

2. Scope and Objective of the Course:

a. *Understand the main elements of power electronic circuits*

b. *Steady-state analysis of basic power electronic circuits like DC-DC converters, rectifiers and inverters*

c. *Development of converter transfer function to locate pol-zero for controller design*

d. *Experimental validation of these power electronic circuits*

e. *Development of one lab prototype power electronic circuit*

3. Text Books:

T1: N. Mohan, T. Undeland, and W. Robbins, *Power Electronics: Converters, Applications, and Design*, 3rd edit. John Wiley & Sons, 2003

T2: Robert W. Erickson, Dragan Maksimovic, *Fundamental Power Electronics*: 2nd edit. Springer International, 2001

4. Reference Books:

R1: J. Kassakian, M. Schlecht, and G. Verghese, *Principles of power electronics*, 3rd edit. Pearson, 2012

R2: P. Krein, *Elements of power electronics*, 2nd edit. Oxford university press, 2011

5. Course Plan:

Module No.	Lecture Session	Reference	Learning outcomes
1. Elements of Power Electronics	L0-L3	T2 (4.1-3); R1(24.1-3)	SPST switch realization using semiconductor devices (MOSFET, Diode and IGBT) for various converter topologies. Analysis of switching losses.
2. DC-DC converters: Buck, Boost, Buck-boost, Flyback, SEPIC, Cuk and other derived converters	L4-L13	T2 (2.1-6, 3.1-6) T1(7.1-8)	Steady state converter analysis in CCM and DCM with loss analysis. Converter component design for a given voltage and current ripple
3. AC-DC conversion: Line commutated and pulse width modulated rectifiers	L14-L20	T1(5.1-7, 6.1-3) T2(17.1-5, 18.1-2)	Analysis and design of single phase and three phase rectifiers. Current harmonics and distortion in voltage waveforms
4. DC-AC conversion: Single Phase and Three Phase Inverters	L21-L28	T1(8.1-7)	Design and analysis of single phase and three phase inverters with low THD. Application of various PWM schemes. Understanding effect of blanking time.
5. Modeling and Control of power converters	L29-L35	T2(7.1-5, 8.2-3, 9.1-5)	Analysis of converter transfer function using various approaches. Effect of negative feedback on the network transfer function
6. Practical converter design considerations and advanced converter design	L36-L40	R1(24.1-3) T2(14.1-2, 15.1-2), class notes	Design of filter and coupled inductor; Gate driver, Snubber circuits and signal generators. Soft switching converters

6. Evaluation Scheme:

Component	Duration	Weightage (%)	Date & Time	Nature of component (Close Book/ Open Book)
Mid-Semester Test	90 Min.	25%	To be announced	Close book/open book
Comprehensive Examination	2 h	30%	4/5	Close book/ open book
Tutorials/quizzes	----	20%	During tutorial hours	Close book/ open book
Laboratory/design assignments	-----	25%	During Lab sessions	Open book/ open book

7. Chamber Consultation Hour: Will be announced

8. Notices: EEE notice board

9. Make-up Policy: Will be given ONLY for genuine cases with prior permission

10. Note (if any): Laboratory experiment details will be provided in the Lab during practical sessions.

Instructor-in-charge
EEE/INSTR F342