Second Semester 2015-16

Part - II

Date: Jan 07, 2016

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 F342 /INSTR F342**

Course Title: **Power Electronics**

Instructor-in-charge: **Dr. PRADYUMN CHATURVEDI**

Room No: 2210-R, (e-mail: pradyumn@pilani.bits-pilani.ac.in)

Instructors: Tutorial: **Hitesh Dutt Mathur, Dheerendra Singh, Pradyumn Chaturvedi, Anand Kumar**

Practical: **Hitesh Dutt Mathur, Hari Om Bansal, Anand Kumar, Ashish Patel, Fani Mani, Aishwarya Pandey, Yogesh Krishnan, Dhananjay Kumar**

1. Scope and Objective of the Course:

Power Electronics (PE) is a branch of engineering which requires the knowledge of Analog/Digital Electronics and Control Systems. Nowadays, PE is employed in applications ranging from few Watts residential to several Megawatts industrial systems and processes. PE is the integral part of modern technology. *Application of semiconductor switching devices such as Diode, BJT, SCR, MOSFET, IGBT, GTO etc. to convert and control the amplitude and direction of power flow to met the load requirements is the main objective of this course.* Power Electronic Converters, Design and their Applications are to be covered with their theoretical aspects, numerical/design issues and laboratory experiments. After successful completion of this course, students will be able to design, simulate and develop power electronic converters including ac/ac converters, ac/dc converters, dc/dc converters & dc/ac converters.

It is expected that students should attend the classes regularly to understand the very basic concepts of converters which have been otherwise taken from several reference books.

2. Text Book:

N. Mohan, T. M. Undeland, and W. P. Robbins, *Power Electronics: Converters, Applications, and Design*, John Wiley & Sons Inc., 2003, Third Edition.

Some necessary topics will be covered in class from different reference books. Class notes will be sufficient for those topics.

3. Course Plan:

Lecture No.	Topic to be Covered	Learning Objectives	Reference to Text Book
1	Power Electronic Systems	Need for Power Conversion; Classifications, Applications and Scope of Power Electronics Processors and Converters; Power Electronics Vs Linear Electronics; Interdisciplinary Nature of Power Electronics	1.1, 1.2, 1.3, 1.4, 1.6
2	Overview of Experiments to be conducted in First Cycle	Trigger/Control/PWM Circuit, MOSFET/IGBT Characteristics, Buck Converter	Lab Manuals

3 - 4	Power semiconductor switches	Overview of semiconductor devices such as Diodes, SCR , GTO and transistors (BJT, MOSFET and IGBT): Ratings	2.1 - 2.11
5-7		Static and dynamic characteristics of SCR, MOSFET, IGBT, GTO, emerging devices and circuits	22.3, 22.5, 23.3, 23.5, 24.2, 24.4, 25.3, 25.6, 26.1 to 26.7
8		Gate and base drive circuits	28.1 - 28.6
9-10		Protection of semiconductor devices, snubber circuit design	Class Notes
11-12	DC-DC Switch Mode Converters (Chopper Circuits)	Control of dc-dc converter, Analysis of Buck converter	7.1 - 7.3
13		Analysis of Boost converter	7.4
14		Analysis of Buck-boost converter	7.5
15		Analysis of Cuk converter	7.6
16-17		Single-quadrant, two quadrant and four quadrant operation with dc motor load, chopper circuit design	7.7, Class Notes
18-20	AC-DC Converter (Rectifiers)	Introduction to thyristor control circuits, Half Wave and Full Wave Rectifier concept, Single phase controlled rectifiers, Line commutated inverter	6.1 - 6.3
21-22		Three phase controlled rectifiers	6.4
23-24		Effect of source inductance, harmonics and power factor control	6.3, 6.4, Class Notes
25		Dual Converters: Single phase dual converter	Class Notes
26		Design of Rectifier Circuits	Class Notes
27-28	DC-AC Converters (Inverters)	Introduction, VSI, CSI, Basic concept of switch mode inverters, square wave and PWM switching schemes, Single phase inverters, Operation, Performance	8.1, 8.2, 8.3
29		Voltage and Harmonic Control	Class Notes
30-32		Three phase inverters: 120 degree mode, 180 degree mode, voltage control, harmonics control	8.4, Class Notes
33, 34		Effect of blanking time on output voltage in PWM inverters, Other inverter switching schemes	8.5, 8.6
35		Current source inverter, Inverter circuit design	Class Notes
36		Advanced inverter topologies (Multilevel Inverter)	Class Notes
37-38	Single phase AC voltage regulators and Cycloconverters	Single phase AC voltage controllers/regulators, Principle of ON/OFF control and phase control, with resistive load, with resistive-inductive load	Class Notes
39		Cycloconverter: single phase	Class Notes
40	Simulation exercises	Simulation Exercises on Power Electronics Converters in Matlab	Class Notes

4. Evaluation Scheme:

Evaluation Component	Duration	Marks (300)	Date & Time	Evaluation Type
Mid-Semester Test	**90 Min**	**90**	17/3 2:00 -3:30 PM	**CB**
Tutorials/Quiz (6 Quizzes)	20 Min	30	During Tutorial Hours	**CB**
Comprehensive Examination	**180 Min**	**120**	11/5 FN	**OB/CB**
Practical: Regular Lab Conduction and Lab Record	-------	24	Regular Lab Sessions	------
End Sem Lab Test	-------	26	To be Announced	**CB**
Lab Assignment	-------	10	To be Announced	------

5. List of Experiments:

Cycle-I

Familiarization with Power Electronics Laboratory (Power Circuit, Control Circuit, Instrumentation/ Measurement etc. with overview of data sheets of MOSFET, IGBT, Diode, LM3524).

1. Study of PWM IC LM 3524.
2. Study of Switching Characteristics of MOSFET.
3. Study of Device Characteristics of MOSFET/IGBT.
4. Buck Converter.

Cycle-II

5. Boost Converter.
6. Single Phase Inverter.
7. Three-Phase Inverter.
8. Single-Phase Controlled Rectifier.

6. Chamber Consultation Hours: To be announced in the class.

7. Notices: EEE Notice Board (FD-II).

8. **Make-Up Examination:** Make-up will be permitted ONLY in case of Sickness Resulting in Hospitalization. No make-up will be permitted for assignments and quizzes.