

# GUJARAT TECHNOLOGICAL UNIVERSITY

## POWER ELECTRONICS ENGINEERING

### B. E. SEMESTER: VII

Subject Name: **Power Electronics Design & Control**

**(Department Elective-I)**

Subject Code: **172406**

Teaching Scheme				Evaluation Scheme			
Theory	Tutorial	Practical	Total	University Exam (E)		Mid Sem Exam (Theory) (M)	Practical (Internal)
				Theory	Practical		
4	0	2	6	70	30	30	20

Sr. No	Course Content	Total Hrs.
1.	<b>Introduction:</b> <ul style="list-style-type: none"> <li>Review of Power Electronics System (PES) – Components &amp; Building Blocks of PES like line filter, power converters, filter</li> <li>Concept of Power, Energy, Signal Processing and Power Processing, Ideal and practical switch characteristics, losses in practical switches and Safe Operating Area (SOA), Switch specifications</li> <li>Review of bode plots, PM, GM</li> </ul>	4
2.	<b>EMI and Input Filter:</b> <ul style="list-style-type: none"> <li>Concept of EMI, Conducted and radiated EMI, importance of understanding EMI</li> <li>Requirement of input filter, Effect of input filter on converter TF, effect of un-damped input filter, damping the input filter</li> <li>Design of damped input filter, Cascading filter sections</li> </ul>	8
3.	<b>Rectifier and DC Filter:</b> <ul style="list-style-type: none"> <li>Review of rectifier with R load, effect of C and LC filter on rectifier input and output</li> <li>Design of rectifier and DC filter (C and LC)</li> </ul>	8

4.	<b>Linear Regulated Power Supply:</b> <ul style="list-style-type: none"> <li>• Design of Series and shunt regulator using discrete components, Power transistor</li> <li>• Efficiency, Regulation, Protection circuits, ripple voltage</li> <li>• Input and output filter</li> <li>• Linear regulator design using IC like 78XX, 79XX, LM 317, LM 337 series</li> </ul>	4
5.	<b>Controller Design for DC-DC Converter:</b> <ul style="list-style-type: none"> <li>• Feedback, effect of feedback on network transfer functions</li> <li>• Construction of <math>1/(1+T)</math>, <math>T/(1+T)</math>, Closed loop TF</li> <li>• Converter Stability, PM test, relation between PM and closed loop damping factor, transient response and damping factor</li> <li>• Typical Regulator design specifications, PD, PI and PID Compensator, Computation of P, I and D gain, Design of controller circuit</li> <li>• Measurement of loop gains, voltage injection, current injection, measurement of unstable system</li> <li>• Design using DC-DC converter IC like SG 3524, TL494, UC3842 etc.</li> </ul>	10
6.	<b>Drive and Protection Circuits:</b> <ul style="list-style-type: none"> <li>• Requirements of Gate drive circuit</li> <li>• Isolated and non-isolated Gate Drive circuits</li> <li>• Requirements and concept of various protections for power electronics devices and converter circuits</li> <li>• Various protections like over voltage, over load, short circuit, <math>dv/dt</math>, <math>di/dt</math>, thermal protection, etc. for various devices like power diodes, Power transistors, MOSFET, IGBT, SCR</li> <li>• Design of Gate drive and protection circuits</li> </ul>	10
7.	<b>Magnetic Design:</b> <ul style="list-style-type: none"> <li>• Concepts of magnetic, Ampere's Law, Faraday's Law, Flux, Flux density, volt-second balance, analogy between electric and magnetic circuits, Magnetic Core materials, types of magnetic devices like inductors, potential transformers, current transformers</li> <li>• Inductors, leakage inductors, filter inductor, AC inductor, design of inductor, multi winding inductor, Flyback inductor/ transformer</li> <li>• Core shapes, Area Product, Window Area, Cross Section Area, window utilization factor, polarity and dot convention, proximity effect</li> </ul>	10

	<ul style="list-style-type: none"> <li>• Potential Transformer, Equivalent Circuit, design of Potential Transformer</li> <li>• Current Transformer, Equivalent Circuit and design</li> </ul>	
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### **Text Books:**

1. Fundamentals of Power Electronics 2<sup>nd</sup> ed., Robert W. Erickson, Dragan Maksimovic
2. Power Electronics Essentials and Applications, L. Umanand

### **Reference Books:**

1. Switching Power Supplies A to Z, Sanjay Maniktala
2. Elements of Power Electronics, Philip T. Krein
3. Power Electronics Converters, Applications and design, Mohan, Undeland, Robbins
4. Power Supply Cookbook, Marty Brown
5. A monograph on Electronics Design Principles, N.C. Goyal, R.K. Khetan
6. Various Power Semiconductor Device manufacturer's Application note and data sheets.