

GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: POWER ELECTRONICS
SUBJECT NAME: ADVANCED POWER ELECTRONICS DEVICES
SUBJECT CODE: 3712918
M.E. 1st SEMESTER

Type of course: Engineering

Prerequisite: Semiconductor physics, Power semiconductor devices, capacitors, transformer, materials etc. at UG level

Rationale:

Power Electronics is a rapidly growing field within electrical engineering as the enabling technology for most of the industry. New materials and technology has been introduced in electronics which has boosted new devices, and structures of devices used in Power Electronics. This is the core subject which serves to introduce new development in the power electronics device technology.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE(E)	PA (M)	PA (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	<ul style="list-style-type: none">Passive devices for power electronics circuitsMaterials for capacitors, characteristics, high temperature operation, high energy density capacitors, super capacitors,Magnetic materials for high and low, their characteristics, Ferrite and powdered coresPower inductors, transformers etc.	8	20
2	<ul style="list-style-type: none">Battery technology and advancements, Different advanced batteries used like Li-ion, Li-Polymer, Fuel Cell, etc. Characteristics of battery, charging and discharging, battery life, protections required etc	8	20
3	<ul style="list-style-type: none">Advanced materials for power electronics devicesWBG materials for power semiconductor devices: SiC and GaN, their characteristics, properties, various types of power semiconductor switch available, their driver requirements, care and protections required, PCB design requirements	8	20
4	<ul style="list-style-type: none">Various equipment used for high power, high frequency operation of power electronics circuits, types of probes and oscilloscopes used: passive and active probes, isolated and non-isolated probes and scopes, their calibration	8	20

	<ul style="list-style-type: none"> • Different types of grounds in a circuit, care to be taken while selection of equipment for measurement of signals with different grounds • Issue of HF noise in signal measurement at high power high frequency operation and its minimization techniques 		
5	<ul style="list-style-type: none"> • Cooling requirements in power electronic systems, Heat sinks and thermal management, forced cooling using cooling fan • Static and transient thermal model • Thermal design for Power Switching device 	8	20

Reference Books:

1. B.J. Baliga, Power Semiconductor Devices, Pws Pub Co
2. B.J. Baliga, Fundamentals of Power Semiconductor Devices, Springer
3. Capacitor, magnetic core, Battery manufacturers data sheets and application notes

Course Outcome:

After learning the course, the students should be able to:

1. Understand Basic Structure of Power Electronics Devices.
2. Understand characteristics of passive devices used in power electronics.
3. Understand characteristics of active devices used in Power Electronics.
4. Understand new materials and devices for Power Electronics.
5. Understand heat management.
6. Understand electrical energy storage.
7. Understand working, characteristics and specifications of probes used for measurement of electrical quantities.

List of Experiments:

Each student can be given case study for different topics given in syllabus.

Major Equipment:

PC with necessary simulation software

List of Open Source Software/learning website:

1. <https://www.nptel.ac.in>
2. <https://www.mathworks.com/>
3. <https://powersimtech.com>
4. <https://www.scilab.org/>
5. <https://www.murata.com>
6. <https://www.mag-inc.com>
7. <https://en.tdk.eu>