

# GUJARAT TECHNOLOGICAL UNIVERSITY

## B. E. SEMESTER: V

### POWER ELECTRONICS ENGINEERING

Subject Name: **Power Electronics Devices & Components**

Subject Code: **152401**

Teaching Scheme				Evaluation Scheme		
Theory	Tutorial	Practical	Total	University Exam (Theory) (E)	Mid Sem Exam (Theory) (M)	Practical (I)
4	0	0	4	70	30	50

Sr. No.	Course Content
1	<b>Introduction:</b> <ul style="list-style-type: none"><li>• Power Electronics System(PES) – Overview, Components &amp; Building Blocks of PES, Concept of Power, Energy</li><li>• Concept of Power Processing</li><li>• Ideal and practical switch characteristics, losses in practical switches and concept of Safe Operating Area (SOA)</li><li>• Switch specifications, Semiconductor materials for Power Switches, Power Switch classification</li></ul>
2	<b>Basic Components and Materials:</b> <ul style="list-style-type: none"><li>• Real sources, Real loads and passive components like R, L, C, transformer and their behavior at different frequencies.</li><li>• Materials for Power Electronics Components</li><li>• Active components like DIAC, UJT, PUT, Opto-coupler etc. and their characteristics, Basic application circuits</li></ul>
3	<b>Power Diodes:</b> <ul style="list-style-type: none"><li>• P-N Junction, current through P-N junction, equivalent circuit of P-N junction diode, reverse recovery</li><li>• Fast Recovery Diode, PiN Diode, Conductivity modulation, Forward, reverse and switching characteristics of PiN diode,</li><li>• Schottky Barrier Diode, Schottky Barrier, Ohmic Junction, HV Schottky Diode Trends in Power Diodes, Junction Barrier Controlled Schottky Diode</li><li>• Losses, series and parallel operation, Specifications/ratings</li></ul>
4	<b>Power BJT:</b> <ul style="list-style-type: none"><li>• Structure , Operating principle</li><li>• Input, output and switching characteristics</li><li>• Physics of power transistor, Break down voltage and Second break down</li><li>• Losses in a Power BJT, SOA, Specifications/ratings,</li><li>• Power darlington, Improving switching speed of Power BJT, Driving circuit and requirements, Protection Circuits</li></ul>

Sr. No.	Course Content
5	<b>Thyristor:</b> <ul style="list-style-type: none"> <li>• Operating principle and construction of SCR (Planner Diffused &amp; Alloy Diffused)</li> <li>• Two transistor Model, Thyristor Turn ON and Turn OFF mechanism</li> <li>• Turn ON Methods of SCR and Gate Driving circuits</li> <li>• Converter Grade and Inverter Grade Thyristors</li> </ul>
6	<b>Thyristor Commutation and Protection Circuits:</b> <ul style="list-style-type: none"> <li>• Commutation and requirements</li> <li>• Class A,B,C,D,E &amp; F Commutations</li> <li>• Thyristor specifications/ratings</li> <li>• Thyristor protections and protection circuits</li> </ul>
7	<b>Power MOSFET:</b> <ul style="list-style-type: none"> <li>• Structure of depletion and enhancement power MOSFET</li> <li>• Input, output and switching characteristics</li> <li>• Equivalent Circuit, losses in a Power MOSFET, SOA</li> <li>• Parallel operation</li> <li>• Power MOSFET specifications/ratings</li> <li>• Driving and protection circuits</li> </ul>
8	<b>IGBT:</b> <ul style="list-style-type: none"> <li>• Construction, working principle, input, output and switching characteristics</li> <li>• Equivalent circuit, losses, SOA</li> <li>• IGBT Ratings/Specifications</li> <li>• Driving and protection circuits</li> </ul>
9	<b>Other Power Devices :</b> <ul style="list-style-type: none"> <li>• Working principle, symbol and applications of Triac, RCT, LASCR, ASCR, SIT, SITH, MCT, MTO, ETO, GTO, Power Integrated Circuits etc</li> </ul>
10	<b>Cooling :</b> <ul style="list-style-type: none"> <li>• Cooling requirements</li> <li>• Heat sink and Mounting</li> </ul>

## Reference Books:

1. Power Electronics Devices, Circuits and Industrial Applications, Oxford, V.R. Moorthi
2. Power Electronics Converters, Applications and design, Wiley, Mohan, Undeland, Robbins
3. Power Electronics Essentials and Applications, Wiley, L. Umanand
4. Elements of Power Electronics, Philip T. Krein
5. Power Electronics, M. D. Singh & Khanchandani
6. Various Power Semiconductor Device manufacturer's Application note and data sheets.