



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering

Level: UG

Branch: Electronics and Communication

Subject Code: BE05000391

Subject Name: Power Electronics

WEF Academic Year :	2025-26
Semester :	5
Category of the Course :	Professional Elective Course - 1

Course Outcome :

After Completion of the Course, Student will able to :

No	Course Outcomes	RBT Level*
01	Understand the power semiconductor devices with terminologies, characteristics and ratings	UN
02	Design and analyze SCR firing and commutation methods.	AN
03	Build and test circuits using power devices such as SCR	AN
04	Analyse ,design and comprehend the operation of controlled rectifiers for possible configurations with different loads	CR
05	Analyze the operation and performance characteristics of choppers and DC to AC inverters, switching power supplies for different topologies	AN
06	To realize drive and control circuits for power converters used for the control of DC and AC drives	CR
07	Evaluate the operation and applications such as power conditioners, UPS, battery chargers, drives	EL

*RM: Remember, UN: Understand, AP: Apply, AN: Analyze, EL: Evaluate, CR: Create

Teaching and Examination Scheme

Teaching/Learning Scheme in hrs/semester					Total Credits	Assessment Pattern and Marks					Total Marks
L	T	P	PBL*	TH	TH/30	Theory		Practical			
						ESE (E)	PA (M)	PA (I)	PBL(I)	ESE (V)	
45	0	30	15	90	3	70	30	20	30	50	200

Where L = Lecture, T= Tutorial, P= Practical, TW/SL = Term-Work / Self-Learning, TH = Total Hours, ESE = End-Semester Examination, PA = Progressive Assessment



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* Problem Based Learning (PBL) aims to accommodate learning beyond syllabus as per clause 9.4 of NBA manual.

Course Content :

Sr. No.	Content	Total Hrs
1	Characteristics of Semiconductor Power Devices: Thyristor, power MOSFET and IGBT- Treatment should consist of structure, Characteristics, operation, ratings, protections and thermal considerations. Brief introduction to power devices viz. TRIAC, MOS controlled thyristor (MCT), Power Integrated Circuit (PIC) (Smart Power), Triggering/Driver, commutation and snubber circuits for thyristor, power MOSFETs and IGBTs (discrete and IC based). Concept of fast recovery and schottky diodes as freewheeling and feedback diode.	12
2	Controlled Rectifiers: Single phase: Study of semi and full bridge converters for R, RL, RLE and level loads. Analysis of load voltage and input current- Derivations of load form factor and ripple factor, Effect of source impedance, Input current Fourier series analysis of input current to derive input supply power factor, displacement factor and harmonic factor	10
3	Choppers: Principle of chopper operation, control strategies, Analysis of Step-Up, Step-down and Step-Up/Down chopper. Quadrant operations of Type A, Type B, Type C, Type D and type E choppers, Control techniques for choppers – TRC and CLC, Detailed analysis of Type A chopper. Step up chopper. Multiphase Choppers	10
4	Single-phase inverters: Principle of operation of full bridge square wave, quasi-square wave, PWM inverters and comparison of their performance. Driver circuits for above inverters and mathematical analysis of output (Fourier series) voltage and harmonic control at output of inverter (Fourier analysis of output voltage). Filters at the output of inverters, Single phase current source inverter	10
5	Switching Power Supplies: Analysis of fly back, forward converters for SMPS, Resonant converters - need, concept of soft switching, switching trajectory and SOAR, Load resonant converter - series loaded half bridge DC-DC converter.	09
6	Applications: Power line disturbances, EMI/EMC, power conditioners. Block diagram and configuration of UPS, salient features of UPS, selection of battery and charger ratings, sizing of UPS. Separately excited DC motor drive. P M Stepper motor Drive., DC Chopper drives, Speed control of Induction Motors. cooling and thermal	08

This syllabus is mapped with following United Nation's Sustainable Development Goals:

SDG 3 - Good Health and Well-being



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SDG 4 - Quality Education.
SDG 7 – Clean and affordable energy,
SDG 8 - Decent Work and Economic Growth,
SDG 9 - Industry, Innovation and Infrastructure,
SDG 11 - Sustainable Cities and Communities,
SDG 12 - Responsible Consumption and Production,
SDG 13 -Climate Action

Relevant BIS standards:

IS 616 – Safety of Electrical Appliances
IS/IEC 60950-1 – IT Equipment Safety
IS 325 – Three Phase Induction Motors
IS 4722 – Rotating Electrical Machines
IS 8789 – Semiconductor Converters
IS 16221 (Part 1 & 2) – Safety of Power Converters for PV Systems
IS 16169 – Grid Connected PV Inverter Requirements
IS 14286 – Solar Photovoltaic Modules
Also explore other relevant Indian and international standards.

Reference Book :

1. Muhammad H. Rashid, “ Powerelectronics” Prentice Hall of India.
2. Ned Mohan, Robbins, “Powerelectronics”, edition III, John Wiley and sons.
3. Abraham I. Pressman, Keith Billings, Taylor Morey, ”Switching Power Supply Design”, edition III, McGraw Hill
4. M.D. Singh and K.B. Khanchandani , “Power Electronics”, Tata McGraw Hill, New Delhi, Second Edition, 2008.
5. P.C. Sen., “ Modern Power Electronics”, edition II, Chand & Co.
6. V.R. Moorthi, “Power Electronics”, Oxford University Press.
7. Cyril W., Lander, ” Power Electronics”, edition III, McGraw Hill.
8. L. Umanand, “Power Electronics: Essentials and Applications”, Wiley India, 2009.
9. George Chryssis "High Frequency Switching Power Supplies : Theory And Design", McGraw Hill

Suggested Course Practical List :

1. To study & plot characteristics of SCR, DIAC and TRIAC
2. To study & plot of characteristics of IGBT.
3. To study the various force commutation methods of SCRs.



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4. Resistance and RC triggered circuits of SCRs.
5. UJT as a relaxation oscillator and SCR firing circuits using UJT.
6. To study & observe the waveform of single phase half and semi converter with resistive and reactive load.
7. To study & observe the waveform of single phase full converter with resistive and reactive load
8. To study and observe the waveforms of series and parallel inverters.
9. To study and observe the waveforms of single phase cycloconverter.
10. To study the step up and step down choppers.
11. To study the speed control of AC and DC drives.
12. To study and measurement of various parameters of UPS.
13. Design of Different switching Power supplies
14. To analyse the characteristics and performance of power devices ,converters and inverters

Major Equipment/software:

Electronic work bench, AC & DC regulated Power Supplies, Earthed and Un Earthed Oscilloscopes, Power Electronics Trainer Kits, Digitalmultimeters, Clipon meters , Regular and 1:10 CRO probs.

List of Laboratory/Learning Resources Required:

- Fritzing (<http://fritzing.org/home/>)
- TINA-TI for circuit simulation (<http://www.ti.com/tool/tina-ti>)
- OSCAD for CAD application (<http://www.oscad.in/downloads>)
- Multisim for circuit simulation (<http://www.ni.com/multisim>)
- <http://sourceforge.net/projects/ktechlab/>
- <http://www.cburch.com/logisim>

Learning website:

- <http://www.datasheetcatalog.com>
- <http://nptel.iitm.ac.in/courses.php>
- <http://ocw.mit.edu>
- <http://www.smpstech.com>
- <http://www.ni.com/white-paper/14676/en/>
- http://www.irf.com/product/_/N~1nje1m
- http://www.allaboutcircuits.com/vol_3/chpt_3/4.html
- <http://www.deltapowersolutions.com/en/tps/rectifiers.php>
- <http://www.electrical-engineering-portal.com>



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Activities suggested under Self-learning/Team Work:

Sl. No.	Name of the activity	No. of hours	Evaluation Criteria
1.	Industry/Research laboratory visit	Visit = 5h, Report preparation = 5h Total = 10h	Based on report submitted. Report should contain observations and calculations based on industry/ lab data.
2.	Technical Video based learning related to the subject	Duration of video = 5h Report preparation = 5h Total = 10h	Report /presentation based on the video learning outcomes.
3.	Assignment writing. Numericals based assignment is preferable.	5 assignments of 2h each. Total = 10h	Based on the assignment submitted.
4.	Problem solving/Coding using C, C++, Python, SCILAB, MATLAB, MS-EXCEL or any other relevant software	5 small coding based assignment of 2h each. Total = 10h	Based on the coding solution submitted.
5.	Self learning on-line course	Minimum duration of the course should be 10h.	Examination based assessment at the end of course. Based on the certificate produced.
6.	Complex problem solving	Maximum 2 problem. Study of the problem and solution finding, Total = 10h	Based on the depth of the solution submitted.
7.	Videos on Industrial safety aspects based on subject	Duration of video = 5h Report preparation = 5h Total = 10h	Based on quiz/report submitted
8.	Discussion on research paper based on relevant subject	5 research paper = 20 h	Summarize research paper and evaluation critical parameters
9.	Poster/chart/power point preparation on technical topics	Duration = 6 h	Based on poster/chart preparation and presentation skills
10.	Working/non-working model on technical topics	Working = 12 h Non- working = 8 h	Based on inter department/external evaluation
11.	Industrial exposure for 2-3 days to observe and provide tentative solutions on society/environment/health/any other issue	Duration = 15 h for industrial exposure Problem identification and tentative solution = 10 h	Based on evaluation of critical problems and solutions



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		Total = 20 h	
12	Group Discussion on emerging/trending technical topics based on subject	Duration = 1 h each	Based on performance in group discussion, technical depth, knowledge etc.
13.	Real world case studies-based learning	Duration of data collection/study = 5h Report preparation = 5h Total = 10h	Based on in-depth study, technical depth, data collected, fact finding, etc.
14.	Application/Software development	Duration = 10 h	Depending on the complexity of the Application/Software

Note:

1. All the suggested activity should be related to the subject.
2. The number of hours are suggestive. Faculty can sub-divide the number of hours based on the activity. However, total number of hours is fixed.
3. Rubrics for the evaluation can be prepared by the faculty.

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