



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: PG

Subject Code: ME02000631

Subject Name: Analysis and Design of Power Converters

w. e. f. Academic Year:	2024-25
Semester:	2
Category of the Course:	PCC

Prerequisite:	Power Electronic concepts.
Rationale:	In today's world, power electronics has become an important technology. Every application where electrical energy is required, conversion and control of electrical energy is a must. For this purpose, power converters from few watts to megawatts are required depending on application and load. This shows the importance of this subject. Hence, in PG program related to Power Electronics this is subject having higher importance.

Course Outcome:

After Completion of the Course, the student will be able to:

No	Course Outcomes
01	Understand working principles of different types of power electronic converters.
02	Analyze different types of power electronic converters.
03	Design the different types of power electronic converters.
04	Classify various types of power electronic converters.

Teaching and Examination Scheme:

Teaching Scheme (in			Total Credits	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Tutorial / Practical		
				ESE	PA / CA (M)	PA/CA (I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	SINGLE PHASE CONTROLLED RECTIFIER: Single Phase AC to DC controlled converter configurations: Semi-converter and fully controlled converter with R, RL, RLE load; Continuous and discontinuous conduction mode; Analysis of supply side power factor and power factor improvement techniques; Effect of source inductance; Dual converter; PWM rectifier. Design and simulation of single-phase controlled rectifier.	8	20
2.	THREE PHASE CONTROLLED RECTIFIER: Three Phase AC to DC controlled converters configurations: Semi-converter and fully controlled converter with R, RL, RLE load; Continuous and discontinuous conduction mode; Harmonic analysis; Effect of source inductance; Multi-quadrant converter; Multi-pulse converter, Design and simulation of three phase controlled rectifier.	9	20



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3.	DC-DC CONVERTERS: Configurations: Buck, Boost, Buck-Boost; Multi-port and interleaved converters; Synchronous, converters; Design and control of DC-DC converter; multi-quadrant choppers and applications, Design of DC-DC converters.	10	25
4.	DC-AC INVERTERS: Single phase Voltage Source Inverter (VSI) and Current Source Inverter (CSI); Three phase VSI and CSI: 120-degree and 180-degree modes of operation; PWM techniques: Sine PWM, space vector PWM; Multilevel Inverters: Types, voltage control and applications; Harmonic spectrum: THD analysis and Harmonic mitigation techniques; Filter design; Device selections	10	25
5.	AC VOLTAGE CONTROLLERS : Single phase and three phase voltage regulators; R and RL load, range of control; Single phase cycloconverters: Types and operating principle, design of AC voltage converters.	8	10
Total		45	100

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (%)					
R Level	U Level	A Level	N Level	E Level	C Level
30	20	20	20	10	0

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. Rashid M.H., "Power Electronics-Circuits, Devices and Applications", Prentice Hall India, New Delhi, 2017.
2. Ned Mohan, Tore M. Undeland, "Power Electronics – Converters, Applications and Design", John Wiley & Sons, 2008.
3. L. Umanand and S. R. Bhat, "Design of Magnetic Components for Switched Mode Power Converters", New Age
4. Joseph Vithayathil, "Power Electronics – Principles and Applications", Tata McGraw-Hill edition, 2010.
5. Bin Wu, Mehdi Narimani, "High-Power Converters and AC Drives", John Wiley & Sons, 2017.
6. William Shepherd and Li Zhang, "Power Converter Circuits", Marcel Dekker Inc, New York, 2004.
7. W. G. Hurley and W. H. Wolfle, "Transformers and Inductors For Power Electronics Theory, Design And Applications", Wiley
8. Issa Batarseh and Ahmad Harb, Power Electronics Circuit Analysis and Design 2nd Ed., Springer
9. Marian K. Kazimierz, "Pulse-width Modulated DC–DC Power Converters", Wiley
10. P.R. K. Chetty, "Switch Mode Power Supply Design", BPB Publication



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(b) Open-source software and website:

1. <https://nptel.ac.in/>

Suggested Course Practical List:

The following list is for suggestions only. The subject teacher can modify the list according to availability of resources.

1. Analysis, design and simulation of controlled rectifier
2. Analysis, design and simulation of DC-DC converter
3. Analysis, design and simulation of DC-AC Inverter
4. Analysis, design and simulation of AC voltage controllers.
5. A hardware project of analysis, design, simulation and implementation of any power converter.

List of Laboratory/Learning Resources Required:

PC/Laptop with installed MATLAB/ similar software

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