FACULTY OF ENGINEERING & TECHNOLOGY

Effective from Academic Batch: 2022-23

Programme: **Bachelor of Technology (Electrical Engineering)**

Semester: **VIII**

Course Code: **202050802**

Course Title: **Advanced Power Electronics converters**

Course Group: **Professional Elective Course-V**

Course Objectives: Electrical in a fast growing industrial environment needs electrical power controls are having very much importance to meet the requirement of various applications. To control these electrical drives, solar system, Electric vehicles and consumer electronics, the use of Advanced power electronics converters are very much needed. This course gives advanced power electronics topologies and their control scheme. Also Various Power converters switching Techniques are being used to control the advanced topologies.

Teaching & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
				Theory		J/V/P*		Total
Lecture	Tutorial	Practical		Internal	External	Internal	External	
3	0	2	4	50 / 18	50 / 17	25/9	25 / 9	150 /53

* **J**: Jury; **V**: Viva; **P**: Practical

Detailed Syllabus:

Sr.	Contents	Hours
1	**ADVANCED DC/DC CONVERTERS:** Linear converters vs switching converters. Classification of SMPS, Concept of steady state in switching converters, Analysis of Buck, Boost, Buck - Boost converters in Continuous Current Mode(CCM), Discontinuous Current Mode (DCM), Boundary Condition, CUK Converter, SEPIC Converter, Transformer-Type Converters, Developed Converters, The Second Generation Converters, Switched Capacitor Converters, Multiple- Quadrant Switched Inductor Converters.	10

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2	**Resonant Converters :** Introduction, Need of resonant converters, Classification of resonant converters, Load resonant converters, Resonant switch converters, zero-voltage switching dc-dc converters, zero current switching dc-dc converters, clamped voltage topologies, Multiple-Quadrant Soft-Switch Converters (ZVS, ZCS).	**08**
3	**Multilevel converters:** Need for multi-level inverters, Concept of multi-level, Topologies for multi-level: Diode Clamped, Flying capacitor and Cascaded H-bridge multilevel Converters configurations; Features and relative comparison of these configurations, Applications, Introduction to Carrier based PWM technique and SVPWM for Multilevel converters.	**07**
4	**Magnetic circuit design:** Design principles, definitions, Design of high frequency Inductor and high frequency transformer.	**05**
5	**Design consideration of gate and protection circuit** : Introduction Necessity of isolation, pulse transformer, opto-coupler – Gate driver circuit for MOSFETs and IGBTs.	**03**
6	**Control Strategies for Power Converters:** PWM techniques, PWM classification, SPWM, Selected harmonic Elimination, Minimum ripple current PWM, Space vector PWM, Hysteresis band current control PWM, Sigma delta modulation.	**05**
7	**Multipulse Converters** : Concept of multi-pulse, Configurations for m-pulse (m=12,18,24 ....) converters, Different phase shifting transformer (Y-Δ1, Y-Δ2, Y-Z1 and Y-Z2) configurations for multi-pulse converters, Applications.	**07**

List of Practicals / Tutorials:

1	Evaluating DC –D C converter with two quadrant operations.
2	Evaluate the performance and operating modes of SLR/PLR dc-dc converter with the change in switching frequency.
3	Simulate/Design a circuit for a Buck Converter with ZVS/ZCS to regulate the output voltage Vo with a given input voltage Vin.
4	Carrier based Sine PWM control of a CHB multilevel inverter and study of harmonic spectrum.
5	To simulate a cascaded multilevel inverter using MATLAB.
6	To simulate a high frequency DC-DC converter.
7	Study the operation and performance of half-bridge, full-bridge, push-pull converters etc
8	Study the operation and performance of fourth order converters like C'uk or Sepic converters.
9	Evaluate the performance of STATCOM/SVC as a shunt compensator.
10	Study of harmonic spectrum for 12 and 18 pulse converters

Reference Books:

1	Advanced DC/DC Converters by Fang Lin Luo, Hong Ye, CRC Press, 2004 EDITION.
2	Ned Mohan, Tore M. Undeland and William P. Robbins, "Power Electronics – Converters, Applications and Design", John Willey & sons, Inc., 3rd ed., 2003.

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3	Muhammad H. Rashid, "Power Electronics - Circuits, Devices and Applications", Prentice Hall of India, 3rd ed., 2009.
4	Bin Wu, "High Power Converters and AC Drives", John Willey & sons, Inc., 2006.
5	Derek A. Paice "Power Electronic Converter Harmonics – Multipulse Methods for Clean Power", IEEE Press, 1996.
6	Muhammad H. Rashid , "Power Electronics Handbook", Elsevier, 3rd ed., 2011.
7	L. Umanand, "Power Electronics Essentials and Applications", Wiley India Ltd., 2009
8	Advanced Power Electronics Converters: PWM Converters Processing AC Voltages (IEEE Press Series on Power and Energy Systems).
9	B.K.Bose , "Modern Power Electronics and AC Drives ", Prentice hall PTR.

Supplementary learning Material:	
1	www.nptel.com

Pedagogy:

- Direct classroom teaching
- Audio Visual presentations/demonstrations
- Assignments/Quiz
- Continuous assessment
- Interactive methods
- Seminar/Poster Presentation
- Industrial/ Field visits
- Course Projects

Internal Evaluation: The internal evaluation comprised of written exam (40% weightage) along with combination of various components such as Certification courses, Assignments, Mini Project, Simulation, Model making, Case study, Group activity, Seminar, Poster Presentation, Unit test, Quiz, Class Participation, Attendance, Achievements etc. where individual component weightage should not exceed 20%.

Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks in %						**R**: Remembering; **U**: Understanding; **A**: Applying; **N**: Analyzing; **E**: Evaluating; **C**: Creating
R	**U**	**A**	**N**	**E**	**C**	
25%	30%	20%	15%	10%	0%	

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

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Course Outcomes (CO):

Sr.	Course Outcome Statements	%weightage
CO-1	To understand the advanced topologies of DC-DC converters, design of inductors and switching techniques to derive the desired output.	**15**
CO-2	To understand the various power converters working on the principle of resonance. To design dc-dc converters to reduce switching losses with minimum components and harmonics.	**15**
CO-3	To understand multilevel converters with more switches which can be used in new solar systems as well as can be used to reduce the harmonic component of output voltage. To design the multilevel converters for high power output.	**40**
CO-4	To understand the optimized pwm approach for control of converters. To study the control of the converter using proportional and integral closed loop control.	**30**

Curriculum Revision:	
Version:	2.0
Drafted on (Month-Year):	June-2022
Last Reviewed on (Month-Year):	
Next Review on (Month-Year):	June-2025

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