INSTITUTE	**FACULTY OF TECHNOLOGY**
PROGRAM	**MASTER OF TECHNOLOGY in ELECTRICAL ENGINEERING**
SEMESTER	**2**
COURSE TITLE	**HIGH POWER CONVERTERS FOR AC DRIVES**
COURSE CODE	**01PE1207**
COURSE CREDITS	**4**

Objective:

1 This objective of this course isto understand, analyse & simulate the different high power converters applied to AC drives.

Course Outcomes: After completion of this course, student will be able to:

1 Analyse the various phase shifting transformer configuration for Multi pulse converters.

2 Evaluate various MLI configurations and design control scheme for them.

3 Design control scheme for current source PWM inverters.

4 Analyse the various configurations of back-back converter and matrix converter for ac-ac conversion.

Pre-requisite of course: Advance Power Electronics

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	0	2	50	30	20	25	25

Contents : Unit	Topics	Contact Hours
1	**Multi-pulse converter & Phase shifting transformer** Concept & Need of multi pulse, Analysis of multi pulse diode rectifier, Types of multi pulse diode rectifier (12, 18, 24 pulse),, Multi pulse SCR rectifiers (12, 18, 24 pulse), Need of phase shifting transformer,, Phase shifting transformer configurations (Y-Z & ?-Z configurations), & its analysis to determine phase shift & current waveforms, Harmonic current cancellation, Application of multi pulse converters.	8

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Contents : Unit	Topics	Contact Hours
2	**Multilevel Inverters & Its Control schemes** Review of two level inverters, review of modulation techniques for 2-level inverters concept & need of multilevel inverters,, Types of multilevel inverters, Cascaded multilevel inverter, Operation with equal and un equal DC source, Carrier based PWM schemes, Diode clamped MLI, Space vector modulation (for 3-level & higher levels), Neutral point voltage control, Carrier based PWM techniques for higher level., Other multilevel VSI, Concept of neutral point clamped inverters, NPC/H-bridge inverter, Multilevel flying capacitor inverters., Features and comparison of MLI configuration, Applications of MLI's.	12
3	**PWM Current Source Inverters** Review of current source inverter, PWM current source inverter configuration,, Modulation techniques (Trapezoidal modulation, Selective harmonic elimination, Space vector modulation), Parallel current source inverters (for high power ratings), Space vector modulation, Load commutated inverter (LCI)	6
4	**Matrix Converter** Fundamentals of matrix converter technology, Conventional matrix converter, Bi- directional switch topologies,, Modulation techniques for matrix converter, Performance and control of matrix converter,, commutation and protection issues, Concept of direct AC-AC frequency converter and Indirect AC-AC frequency conversion with DC link storage	8
5	**Back to Back Converters & Its Control Schemes** Single phase & three phase full bridge converter configurations, PWM strategy & control approach,, Power Analysis, DC link capacitor voltage & Capacitor bank design, Topology with component count reduction,, Series and parallel connection of converters, Control strategy, Other Back-To-Back converters.	8
Total Hours		**42**

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	**Experiment No. 01** Simulation of a basic converter and inverter system for AC motor drive.	2
2	**Experiment No. 02** Simulate a three-phase controlled and uncontrolled rectifier circuit and study its operation in an AC drive system.	2
3	**Experiment No. 03** Simulate a DC link with a DC-AC inverter for converting DC to AC for driving the motor.	2
4	**Experiment No. 04** Simulate and analyze Pulse Width Modulation (PWM) techniques used to control the output of an inverter in AC drive systems.	2

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Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
5	**Experiment No. 05** Implement Voltage-to-Frequency (V/f) control for speed regulation of an induction motor using a PWM-controlled inverter.	2
6	**Experiment No. 06** Implement and simulate Field-Oriented Control (FOC) for an induction motor to achieve high-performance torque and speed control.	2
7	**Experiment No. 07** Simulate and analyze the operation of an Active Front-End (AFE) converter in high-power AC drives.	2
8	**Experiment No. 08** Simulate and analyze the operation of a matrix converter for direct AC-to-AC power conversion in AC drives.	2
9	**Experiment No. 09** Simulate a multi-level inverter system for high-power AC drives and study its advantages.	2
10	**Experiment No. 10** Simulate the start-up and speed control of an induction motor using a soft-start converter.	2
Total Hours		**20**

Textbook :

1 High Power Converters and AC Drives, Bin Wu, John Willey & sons, Inc., 2006

2 Power Electronic Converter Harmonics – Multi pulse Methods for Clean Power, Derek A. Paice, IEEE Press, 1996

3 Advanced Power Electronics Converters - PWM Converters Processing AC Voltages, Euzeli Cipriano dos Santos Jr. and Edison Roberto Cabral Da Silva, Willey – IEEE Press, 2014

4 Power Electronics Handbook, Muhammad H. Rashid, Elsevier, 3rd ed., 2011

References:

1 Power Electronics Handbook, Power Electronics Handbook, Muhammad H. Rashid, Elsevier, 3rd ed., 2011

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember / Knowledge	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Higher order Thinking / Creative**
5.00	10.00	15.00	30.00	20.00	20.00

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Instructional Method:

1 The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc

2 The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.

3 Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory.

4 Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory.

Supplementary Resources:

1 https://archive.nptel.ac.in/courses/108/102/108102157/

2 https://onlinecourses.nptel.ac.in/noc22_ee16/preview

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