FACULTY OF ENGINEERING & TECHNOLOGY

Effective from Academic Batch: 2022-23

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

Semester: **VI**

Course Code: **202050603**

Course Title: **Power Electronics & Drives- II**

Course Group: **Professional Core Course -XI**

Course Objectives: To provide a general overview DC AC converter, principal operation and control of AC voltage controllers, Cycloconverters, Induction motor drives and synchronous motor drives. Study of special motor such as BLDC, PMSM and their controls.

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 / 09	25 / 09	150 / 53

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

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Detailed Syllabus:

Sr.	Contents	Hours
1	**AC CONVERTERS: INVERTERS** Performance parameters of Inverters; Classification of Inverters: Voltage source inverters and Current source inverters; Single phase inverters: series, parallel and bridge type (Half wave and Full wave) inverters; Forced Commutated, Line commutated and Self-Controlled Switches based Inverters; Three phase bridge inverters: 180-degree conduction, 120-degree conduction and their comparison. PWM Inverters: Principle of PWM control, PWM techniques classifications, Unipolar and Bipolar PWM, Effect of Switching frequency on Harmonic Spectrum, Sinusoidal PWM, Third harmonic PWM, Selective Harmonic Elimination, Hysteresis band current control PWM, Space vector pulse width modulation technique, Comparison of PWM techniques, Voltage and frequency control of single phase and three-phase inverters, Harmonic Cancellation techniques, Gating circuits for switches of inverter, Gate driver ICs having high side and low side reference output for driving switches of legs of inverters (like IR25604) Current Source Inverters: single phase and three phase ASCI and self- controlled switch-based inverters; Comparison of Voltage and Current source Inverters.	**15**
2	**AC VOLTAGE CONTROLLERS:** Concept of On-Off or integral cycle control and Phase control; Various single phase full wave ac-ac controllers with R, L and RL load; Analysis for phase control and integral cycle control; Gating requirements; Sequence Control of AC regulators; 3-phase full wave converter configurations with Y and Δ connected loads and their analysis with R load; AC Voltage controller with PWM control; Basic principle of matrix converter	**08**
3	**CYCLOCONVERTERS:** Introduction; Basic Principle; Single to single-phase cycloconverters; Three-phase half-wave cycloconverters; Cycloconverters for three phase output; Output voltage equation; Output harmonics in cycloconverter; Comparison between cycloconverter and DC link Converter; Load Commutated cycloconverter.	**06**
4	**Induction Motor Drives** Comparison of ac & dc drive; their selection for particular application; Review of Induction Motor fundamentals: Equivalent circuit, Characteristics, Basic Equations and speed control methods; motoring and braking. Soft starting: Stator voltage control with AC voltage controller; Six-step VSI inverter-based drives; PWM-VSI drives; Braking and multi-quadrant operation of VSI drives; Cycloconverter based induction motor drive; Variable frequency control from a current source; Slip power control using Rotor resistance along-with chopper; Closed loop control schemes; Effect of non-sinusoidal waveform on AC machine performance;	**10**

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5	**BLDC and PM motor Drives:** BLDC motor construction, speed control of BLDC motors, converters for BLDC motor control, Permanent Magnet Motor Drives, Switch Reluctance Motor Drives, SR converters, Configuration and control of Drives	**06**

List of Practicals / Tutorials:

1	Performance of full bridge inverter using MATLAB
2	Performance of a PWM half bridge and inverter using MATLAB
3	Performance of a PWM full bridge and inverter using MATLAB
4	Performance Half wave AC voltage controller with R and R-L load using MATLAB.
5	Performance of a full wave AC volt Controller with R and R-L load using MATLAB
6	Performance of three phase AC voltage controller using MATALB.
7	Performance of 3 phase inverter 180 deg mode using MATLAB.
8	Performance of 3 phase inverter 120 deg mode using MATLAB.
9	To perform 3-ph Induction Motor control using variable frequency variable voltage control with the help of IGBT devices.
10	Performance of stepped wave inverter using MATLAB.
11	Performance of step-down cyclo-converter using MATLAB
12	Performance of step-up cyclo-converter using MATLAB
13	Performance of BLDC drive using MATLAB.

Reference Books:

1	Muhammad H. Rashid, Power Electronics: Circuits, Devices and Applications, Pearson Education, New Delhi
2	M. D. Singh and K. B. Khanchandani, Power Electronics, Tata McGraw-Hill Publishing Company Ltd., New Delhi
3	P. S. Bhimbra, Power Electronics, Khanna Publishers, New Delhi
4	Ned Mohan, Tore M. Undeland and William P. Robbins, Power Electronics: Converters, Applications and Design, John Wiley & Sons, Inc., New York
5	Bimal K. Bose, "Modern Power Electronics and AC Drives "-Prentice Hall (2001)-1
6	G. K. Dubey, Fundamental of Electrical Drives, Narosa Publication
7	R. Krishnanan, Electric Motor Drives: Modeling, Analysis and Control, Pearson Publications.
8	Vedam Subramanyam, "Power Electronics – Devices, Converters and Applications", New Age International Publishers Pvt. Ltd., Bangalore, 2nd ed. 2006.
9	K. T. Chau - Electric Vehicle Machines and Drives_ Design, Analysis and Application-Wiley-IEEE Press (2015)

Supplementary learning Material:	
1	NPTEL Course : Electric Drives Link: https://nptel.ac.in/courses/108104140
2	Coursera Course : Power Electronics Specialization

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	Link : https://www.coursera.org/specializations/power-electronics
3	https://nptel.ac.in/courses/108101126

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%	25%	20%	10%	10%	10%	

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	Analyze operation of devices and choose the same suitable for an application	**10**
CO-2	Analyze and compare the performance of various AC to DC Converter	**30**
CO-3	Analyze and compare the performance of Various DC to DC Converter	**30**
CO-4	Analyze different control circuits of dc motor drives	**25**
CO-5	Design a prototype model of Power electronics converter & DC Drives	**05**

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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