Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2023-24

Course Information

Programme	M. Tech. (Power System Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	7OE506
Course Name	Open Elective: Control Techniques for Electrical Drives
Desired Requisites:	M. Tech. (Power System Engineering)

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	--	30	20	50	100
		Credits: 3			

Course Objectives

1	To make students understand concept of fundamental knowledge in dynamics and control of Electric Drives.
2	To strengthen control principles of various DC and AC motors using solid state converters.
3	To cover principles of selection of Electric Motors and highlights the applications of Electrical Drives.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Explain the various concepts used in Electric drives.	II	Understanding
CO2	Apply the control techniques for Electric drives for speed control.	III	Applying
CO3	Analyze the performance of various control techniques used in speed control of electric drives and select a drive for particular application.	IV	Analyzing

Module	**Module Contents**	**Hours**
I	**Fundamentals of Electric Drives** Types & parts of the Electrical drives, Selection criteria of drives, motor rating, selection based on duty cycle, selection of converter rating, fundamental torque equation, speed torques characteristics DC motor & Induction motor, multi quadrant operation of the drive, classification of mechanical load torques, steady state stability of the drive, constant torque and constant HP operation of the drive, closed loop speed control.	7
II	**DC Motor Drives** Methods of speed control, starting and braking operation, single phase and three phases full controlled and half controlled converter fed DC drives, Multi quadrant operation of separately excited DC shunt motor, dual converter fed DC drives, circulating and non – circulating mode of operation, converter fed DC series motor drive, chopper control of DC shunt and series motor drives, four quadrant operation of chopper fed DC shunt motor drive.	7

III	**Induction Motor Drives** Torque equation, Speed control methods for three phase cage induction motor, braking methods, stator voltage control induction motor drive, VSI fed induction motor drive, constant torque (constant E/F and constant V/F), constant HP operation, closed loop speed control block diagram, Stator current control methods fed induction motor drive, speed torque characteristics of CSI fed drive, closed loop speed control block diagram, comparison of CSI fed and VSI fed induction motor drive.	6
IV	**Slip Ring Induction Motor Drives** Chopper controlled resistance in rotor circuit, slip power recovery using converter cascade in rotor circuit, sub synchronous and super synchronous speed control, Kramer speed control, cyclo - converter in rotor circuit.	7
V	**Synchronous Motor Drives and Brushless DC Motor Drives** VSI fed synchronous motor drives, true synchronous and self-control mode, open loop and closed loop speed control of Permanent magnet synchronous machine, brushless DC motor drives.	6
VI	**Special Drives** Construction and operating principle of switched reluctance motors, Current / Voltage control, torque equation, converter circuits, operating modes and applications of switched reluctance motors. Solar panel VI characteristics, solar powered pump, maximum power point tracking and battery-operated vehicles.	6

Textbooks	
1	G. K. Dubey, *"Fundamentals of Electrical Drives*", Narosa publication, 2nd edition, 2002.

References	
1	*"Fundamentals of Electrical Drives",* NPTEL video lecture series by Prof. Shyama Prasad Das, Department of Electrical Engineering, IIT Kanpur.
2	"*Power Electronics - Converter Application",* By N. Mohan T.M. Undel and W. P. Robbins, John Wiely and sons.
3	"*Electrical Drives - Concept and application*", Vedam Subramanyam.

Useful Links	
1	https://nptel.ac.in/courses/108/104/108104140/

CO-PO Mapping						
Programme Outcomes (PO)						
	1	2	3	4	5	6
CO1			3			
CO2				3		
CO3	3					
The strength of mapping is to be written as 1: Low, 2: Medium, 3: High Each CO of the course must map to at least one PO.						

Assessment
The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)