Semester- II
Open Elective (Theory)
Courses

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2023-24

Course Information

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

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

Course Objectives

1	To provide the latest knowledge in the field of electrical drives.
2	To provide sufficient knowledge in the area of advanced control techniques for induction motor and synchronous machines.
3	To make the student aware of the research in the field 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** various concept used in AC and DC drives.	III	Applying
CO2	**Apply** control techniques to AC and DC drives.	III	Applying
CO3	**Analyze** control techniques for AC and DC drives.	IV	Analyzing
CO4	**Evaluate** various control schemes of AC and DC drives.	V	Evaluate

Module	Module Contents	Hours
I	**Basics of drives** Types & parts of the Electrical drives, 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.	5
II	**DC motor drives** Methods of speed control, starting and breaking operation, single phase and three phase 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, chopper control of DC shunt motor drives, four quadrant operation of chopper fed DC shunt motor drive.	7
III	**Induction motor drives** Speed control methods for three phase induction motor, VSI fed induction motor drive, constant torque (constant E/F and constant V/F), constant HP operation, closed loop speed control block diagram., CSI 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, Stator voltage control. 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.	7

IV	**Modeling of Induction Motor and PWM Techniques** abc – dq transformation, transformation from stationary reference frame to synchronously rotating reference frame and vice versa. Equivalent circuits of induction motor in dynamic dq stationary and synchronously rotating reference frame. Permanent magnet synchronous machine dq equivalent circuits. The three phase six step bridge inverter, three phase PWM inverter, PWM techniques such as sinusoidal PWM, hysteresis band current control PWM.	6
V	**Vector Control and Direct Torque Control of Induction Motor** Vector control of induction motor, DC drive analogy, equivalent circuit, phasor diagram. Direct rotor flux oriented vector control and indirect rotor flux oriented vector control, stator flux oriented vector control. Torque equation of IM in terms of stator and rotor flux, direct torque and flux control method (DTC) and self-commissioning of the drive.	7
VI	**Synchronous motor and SRM 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. Switched reluctance motor drives, torque equation, converter circuits, operating modes and applications. Solar panel VI characteristics, solar powered pump, maximum power point tracking and battery operated vehicles.	7

Textbooks

1	G. K. Dubey, *"Fundamentals of Electrical Drives"*, Narosa publication, 2nd edition, 2002.
2	B. K. Bose, *"Modern Power Electronics and AC drives"*, Prentice Hall of India Pvt. India, 1986.
3	

References

1	Peter Vas, *"Vector Control of AC machines"*, Clarendon Press Oxford, 1999.
2	Ned Mohan, *"Advanced Electrical drives – Analysis, control and modeling using Simulink"*, John Wiley and sons, 2001.
3	P. S. Bhimra, *"Power Electronics"*, 2nd edition, Khanna Publishers.

Useful Links

1	NPTEL video lectures on Electrical Drives

CO-PO Mapping

	Programme Outcomes (POs)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1				1		
CO2				1		
CO3			1	2		1
CO4			1	3		

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to atleast 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)