

## PPE202 ADVANCED ELECTRIC DRIVES AND CONTROL

L	T	P	Cr
3	0	2	4.0

**Course Objectives:** To impart knowledge about fundamentals of Electric drives and control, operational strategies of dc and ac motor drives as per different quadrant operations and to discuss

**Review of Drive Concept:** Review of introductory concepts of drives.

**DC Motor Drive and its Operational Strategies:** Dynamic model of machine with armature voltage control only and converters with continuous conduction only; Closed loop control using single (speed) and two loops (speed, current), Implementation using circulating current type three phase dual converter and four quadrant transistorized chopper.

**Modelling and Control of DC Drives:** State feedback control and sliding mode control of separately-excited DC machine, Modelling and control of separately-excited DC machine in field weakening region and discontinuous converter conduction mode, Control of DC series machine.

**Open-loop Dynamic Performance of AC & DC Drives:** Starting & reversal time, Energy consumption & energy savings principle. Drives Application Engineering for Fan, Pump, Compressor, Lift-Elevator, Kiln, Winder-Un-Winder, Traction application. Synchronization and master-slave configuration.

**AC Drives and its Operational Strategies:** Variable frequency operation of three-phase symmetrical induction machine, Scalar control methods for constant power and constant torque modes, Vector control of induction machine, Methods of field sensing and estimation, Field orientation methods: Implementation of IRFO scheme using current controlled PWM, VSI and implementation of DSFO scheme using CSI, Performance of vector controlled permanent magnet machine.

**CONTROL AND ESTIMATION OF AC DRIVES:** Introduction to speed control of Switched Reluctance Machine, Induction motor drive, basic of Scalar & Vector control V/f Control, Sensorless vector control, Field Oriented Control, Direct torque control and flux observation, Speed control of wound rotor induction motors: Converter based static rotor resistance control, Static Scherbius drive using line commutated converter cascade, Analysis and estimation of harmonics and power factor, Vector control of wound rotor induction machine using self-commutated converter cascade and improvement in power factor, Variable speed constant frequency (VSCF) generation.

**CONTROL OF PERMANENT MAGNET MACHINE:** Power Electronics Control of Permanent magnet synchronous machine, Brushless DC machine, Surface permanent magnet machine and interior.

**COMPATIBILITY OF MOTOR & DRIVES:** Effects of drives on motor -  $dV/dt$ , THD, Common Mode Voltage, Shaft Voltage and Bearing Current, Sound & Vibration

**Laboratory Work:** Closed loop current-speed control of AC & DC drives, Variable voltage-variable frequency control, Vector control mechanism, Position control of stepper motor, Direct field orientation of AC drives, Static Scherbius & Kramer method of slip power recovery, PWM based VSI control of induction drive, Converter based Four quadrant operation of DC and AC drives.

**Course Learning Outcome:** On the completion of the course, the student will be able

- To acquire the knowledge of selection of drives as per practical operational industrial requirement.
- To apply their knowledge to prepare control schemes as per different types of motors used in industries.
- To estimate & solve harmonic and power factor related problems in controlling AC and DC drives.

**Recommended Books**

1. Mohan, N., *Electric Drives: An Integrative Approach*, MNPERE (2001).
2. Mohan, N., *Advanced Electric Drives: Analysis, Control, and Modeling Using Simulink*, MNPERE (2001).
3. Krishnan, R., *Electric Motor & Drives: Modeling, Analysis & Control*, PHI Pvt. Ltd. (2001).
4. Bose B.K., *Modern Power Electronics & AC Drives*, PHI Pvt. Ltd., (2001)
5. Leonard, W., *Control of Electric Drives*, Springer-Verlag, New York, (1985)
6. Miller, T.J.E., *Brushless Permanent Magnet and Reluctance Motor Drives*, Oxford Science, Oxford (1989).

**Evaluation Scheme:**

<b>S. No.</b>	<b>Evaluation Elements</b>	<b>Weightage (%)</b>
1.	MST	25
2.	EST	40
3.	Sessionals (May include Assignments/Projects/Tutorials/Quizes etc.)	35