EEPE4001 ELECTRIC DRIVES & CONTROL (3-0-0)

Course objectives:

After completing this course, students will be able to:

1. Understand the dynamics of electrical drives, torque equations, and load characteristics.
2. Analyze starting, braking, and speed control methods of DC, induction, and synchronous motor drives.
3. Study the operation of controlled rectifiers, choppers, and converters used in drive systems.
4. Compare fixed-speed and variable-speed drive techniques for industrial applications.
5. Select appropriate drive and control methods for a given load and operating condition.

Module I (07 Hrs)

Dynamics of Electrical Drives: Introduction, fundamental torque equations, multi-quadrant operations, components of load torque, steady state, and transient stability. Modified characteristics of DC shunt, series motors, and methods of starting. Characteristics of three-phase induction motors and synchronous motors, and starting methods, industrial applications.

Module II (05 Hrs)

Electric Braking: types of braking-regenerative braking, dynamic braking, and plugging, braking of DC motors during lowering of loads and while stopping, electric braking of induction motors, braking of synchronous motors, dynamics of braking.

Module III (05 Hrs)

Introduction to solid state-controlled drives: Controlled rectifier-fed DC drives, single phase and three phase half-controlled and fully controlled rectifier control of DC separately excited motor, rectifier control of DC series motor, chopper control of DC separately excited and DC series motors.

Module III (08 Hrs)

Induction motor Drives: speed control, pole changing, stator voltage control, variable frequency control from voltage sources, closed loop speed control of VSI and CSI fed induction motor drives, Rotor resistance control, slip power recovery, static Scherbius drive, and Kramer drive, variable speed constant frequency generation, starting, braking, and speed control of single-phase induction motors.

Module IV (05 Hrs)

Synchronous motor Drives: Operation from fixed frequency supply, synchronous motor variable speed drives, variable frequency control of multiple synchronous motors, self-controlled synchronous motor drive employing load commutated thyristor inverter, and a cyclo converter

Course Outcomes (CO):

CO1: Explain the fundamentals of electrical drive dynamics, including torque equations, load torque components, steady-state operation, transient stability, and multi-quadrant operation.

CO2: Analyze the modified characteristics, starting methods, and operating performance of DC shunt, DC series, induction, and synchronous motors.

CO3: Compare and evaluate electric braking methods such as regenerative braking, dynamic braking, and plugging for DC, induction, and synchronous motor drives.

CO4: Analyze controlled rectifier-fed and chopper-fed DC drives, including separately excited and series motor control.

CO5: Evaluate induction motor speed control techniques such as stator voltage control, pole changing, rotor resistance control, slip power recovery, and variable frequency control from voltage-source and current-source inverters.

CO6: Explain synchronous motor variable-speed drives, including self-controlled operation, load-commutated thyristor inverter drives, cycloconverter drives, and industrial applications of modern drive systems.

Text Book(s):

1. "Fundamentals of Electrical Drives" by Gopal K. Dubey, second edition, Alpha science int. Ltd., 2001.
2. "A first course on Electrical Drives", by S.K. Pillai, second edition, New Age International (P) Ltd., 2004
3. "Electric Drives" by Nisit K. De and Prasanta K. Sen, Prentice Hall of India Private Limited, 2006.
4. "Electrical Machine Drives and Control- An introduction", by J. Pyrhonene, V. Hrabovcova, R. S. Semken, Wiley, 2016

Reference Book(s):

1. "Control of Electrical Drives", by Werner Leonhard, Second edition, Springer, 1996
2. Mohamed El-Sharkawi, "Fundamentals of Electric Drive," CL- Engineering, 1st Edition, 2000
3. Bimal K. Bose, "Modern Power Electronics and AC Drives," Prentice-Hall, Inc.,2002
4. D. W. Novotny, T. A. Lipo, "Vector Control and Dynamics of AC Drives," Clarendon Press, 1996.
5. R. Krishnan, "Electric Motor Drives - Modelling, Analysis and Control," 1st Edition, Pearson Education, Inc., 2001