Industrial Drives and Control(404184)

Teaching Scheme:
Lectures: 3 Hrs/ Week
Practical: 2 Hrs/ Week

Examination Scheme:
In Semester Assessment:
Phase I : 30
End Semester Examination:
Phase II: 70

Course Objectives:

- Describe the structure of Electric Drive systems and their role in various applications such as flexible production systems, energy conservation, renewable energy, transportation etc., making Electric Drives an enabling technology.
- Study and understand the operation of electric motor drives controlled from a power electronic converter and to introduce the design concepts of controllers for closed loop operation
- Study DC, AC, special machines like stepper motor, servo motor and brushless motor and their control.

Course Outcomes:

Understand the basic principles of power electronics in drives and its control, types of drives and basic requirements placed by mechanical systems on electric drives.

Understand the operation of 1ϕ & 3ϕ converter drives for separately excited & series DC motors, dual converter drives, 2 quadrant and 4 quadrant DC chopper drives, Open-loop & closed-loop control of DC drives with transfer function, Dynamic and regenerative braking. Protection circuits for DC drives.

Learn speed control of induction motor drives in an energy efficient manner using power electronics. To study and understand the operation of both classical and modern induction motor drives.

Learn and understand working of cylindrical-rotor motor, salient-pole motor, reluctance motor, and permanent-magnet motors.

Learn closed loop V/f control and load-commutated inverter (LCI) control. Variable reluctance & permanent magnet stepper motors & drives, switched reluctance motors & drives, brushless DC and AC motors & drives.

Unit I : DC Drives 6 L

Basic characteristics of DC motors, Operating modes, Motor performance parameters, 1ϕ & 3ϕ converter drives for separately excited & series DC motors for continuous & discontinuous operations. Chopper fed DC drives, Comparison of converter fed drive & chopper fed drive. Open loop & closed loop control of dc drives with transfer function PLL control, Microprocessor based control of dc drives, Dynamic and regenerative braking

of DC motors

Unit II: Induction Motor Drives & Control 6 L

Induction motor characteristics, Control strategies like stator voltage control, v/f control, rotor resistance control, Variable frequency Square wave VSI Drives, Variable frequency PWM VSI Drives, Variable frequency CSI Drives, Closed loop control of Induction motors, v/f control of three phase IM using PWM inverter, Vector Control (Field oriented Control): Basic principle of vector control, Direct vector control & indirect vector control, DQ Transformation, Braking of induction motor, soft acceleration and deceleration, various protections.

Unit III: Special Motor Drives I 6 L

Cylindrical rotor motor Drive, Salient pole motor Drive, Switched reluctance motor (SRM) drive, Synchronous Reluctance motor drive, self-controlled synchronous motor drives

Unit IV: Special Motor Drives II 6 L

Permanent magnet Brushless DC motor drive, Permanent magnet AC synchronous motor drive, Variable reluctance & permanent magnet stepper motor, Stepper motor drives

Servo motor Drives.

Unit V : Drive Applications in Renewable Energy 6 L

Power Electronics for wind power systems

Wind power system: System component, Turbine rating, Electrical load matching, fixed speed and variable speed operation, System design features, Maximum power operations and System control requirement

WECS: Principle of WECS, role of power electronics in WECS, Drive selection criteria for fixed speed and variable speed WECS, Stand-alone PV systems, Grid connected PV systems.

Power Electronics for Photovoltaic Power Systems

Basics of Photovoltaic: The PV cell, Module and array, I-V and P-V curves, PV system component, Stand-alone PV systems, Grid connected PV systems.

Unit VI: Applications of Artificial neural network and fuzzy logic in Drives 6 L

Fuzzy logic Principle and applications: Introduction, Fuzzy sets, Fuzzy system, Fuzzy control, Fuzzy logic based induction motor speed control.

Neural network principle and applications: Introduction, Neural network in identification and control, AI Applications in electrical machines and drives, Neural network based PWM controller

Text Books

1. Fundamental of Electrical Drives, Gopal K. Dubey, Narosa Publishing House
2. Modern Power Electronics and AC Drives, Bimal K. Bose, Pearson

Reference Books

1. Wind & Solar Power system, Mukund Patel , CRC Press
2. Thyristor DC drives, P. C Sen, John Wiley.
3. Power Electronics, Converters, Applications and Design, N. Mohan, T. M. Undeland & W. P. Robbins, John Wiley and Sons, 3rd Edition

Practical List (Any Eight experiments)

1. DC motor control using semi/full 1-Φ /3-Φ converter. (Open loop and closed loop)

2. 4-Quadrant chopper fed reversible DC drive

3. Dual converter fed DC Drive (Single phase/ Three phase)

4. V/f controlled AC induction motor drive

5. Speed Control of Universal Motor.

6. Stepper motor drive.

7. BLDC Motor drive.

8. Three phase brushless generator for wind energy applications.

9. Simulation of closed loop controlled DC drive using PSIM/Matlab/MathCad

10. Simulation of Closed loop controlled AC motor drive using PSIM / Matlab/MathCad.