

EEPE3004 SPECIAL ELECTRICAL MACHINES (3-0-0)

Course Objectives:

This course explores the principles, operation, and applications of special electrical machines including stepper, BLDC, PMSM, servo, and linear motors. Students will analyze performance characteristics, derive key equations, implement control strategies, and evaluate machine selection for various industrial applications using simulation tools and practical experiments.

Module-I: (06 Hrs.)

Stepper Motor: -Variable Reluctance type, permanent magnet type, hybrid stepper motor, windings, torque equation, characteristics, open-loop and closed-loop control, applications.

Switched Reluctance Motor: - Construction, Principle of working, torque equation and characteristics, control of switched reluctance motor, applications.

Module-II: (06 Hrs.)

Brushless DC motor: - Permanent magnet DC motor, construction, principle of working, characteristics, classification of BLDC motors, construction, electronic commutation, principle of operation, types of BLDC motor, control of BLDC motor, applications.

Permanent Magnet synchronous motor: - Principle of operation, EMF equation, torque equation, control of PMSM, applications.

Module-III: (06 Hrs.)

Synchronous Reluctance motor: - Construction, working, phasor diagram, control, applications.

Servo motors: DC servo motors- construction, Principle of operation, voltage equation, characteristics, transfer function, control, applications.

AC servo motors: - construction, working, analysis, torque-speed characteristics, transfer function, applications.

Module-IV: (06 Hrs.)

AC series motor, Repulsion motor, Hysteresis motor, single-phase reluctance motor, universal motor- construction, principle of working, characteristics, applications.

Module-V: (06 Hrs.)

Linear Induction Motor: - Construction, performance equations, equivalent circuit, control, applications

Linear synchronous motor: types, control, applications

Linear reluctance motor: - construction, working, applications.

Course Outcomes:

On completion of this course, students are able to:

- CO1 Explain the construction, operating principle and key characteristics of special electrical machines (stepper, SRM, BLDC, PMSM, synchronous-reluctance, servo, hysteresis, AC series/repulsion/universal, linear machines).
- CO2 Derive and analyse performance equations (torque, EMF, equivalent circuits, torque-speed) for various special machines.
- CO3 Describe and apply control strategies: open-loop/closed-loop for steppers, electronic commutation for BLDC, FOC for PMSM, current profiling for SRM, micro stepping, servo control and linear-machine drives.
- CO4 Evaluate and select appropriate special machines for given applications based on efficiency, torque ripple, power density and dynamic response.
- CO5 Utilize simulation tools (e.g., MATLAB/Simulink) and laboratory setups to model, simulate and experimentally verify machine performance.

Text Book(s):

1. E.G. Janardanan, Special Electrical Machines, PHI Learning Pvt. Ltd., Delhi, 2014.
2. K. Venkataratnam , Special Electrical Machines, Universities Press (India) Pvt. Ltd., Hyderabad, 2008.
3. J. F. Gieras, Z. Chen, M. Wing , Permanent Magnet Motor Technology: Design and Applications, CRC Press, 2015.

Reference Book(s):

1. R. Krishnan, Electric Motor Drives: Modeling, Analysis, and Control, Prentice Hall, New Jersey, 2001.
2. T.J.E. Miller, Brushless permanent-magnet and reluctance motor drives, Oxford University Press, 1989.
3. R. Krishnan, Switched Reluctance Motor Drives: Modeling, Simulation, Analysis, Design and Applications. CRC Press, 2001.
4. M. Boldea, S. A. Nasar, Linear Electric Motors: Theory, Design, and Practical Applications, CRC Press, 2006.