

**EE744PE: SPECIAL MACHINES  
(PROFESSIONAL ELECTIVE – IV)**

**B.Tech. IV Year I Sem.**

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**Prerequisite:** Electrical Machines - I & Electrical Machines - II

**Course objectives:**

- To understand the working and construction of special machines
- To know the use of special machines in different feed-back systems
- To understand the use of micro-processors for controlling different machines

**Course Outcomes:** Upon the completion of this subject, the student will be able

- To select different special machines as part of control system components
- To use special machines as transducers for converting physical signals into electrical signals
- To use micro-processors for controlling different machines
- To understand the operation of different special machines

**UNIT – I**

**Special Types of DC Machines - I:** Series Booster-Shunt Booster-Non-reversible boost-Reversible booster

**Special Types of DC Machines – II:** Armature excited machines—Rosenberg generator-The Amplidyne and metadyne— Rototrol and Regulex-third brush generator-three-wire generator-dynamometer.

**UNIT – II**

**Stepper Motors:** Introduction-synchronous inductor (or hybrid stepper motor), Hybrid stepping motor, construction, principles of operation, Energisation with two phase at a time-essential conditions for the satisfactory operation of a 2-phase hybrid step motor- very slow-speed synchronous motor for servo control-different configurations for switching the phase windings-control circuits for stepping motors-an open-loop controller for a 2-phase stepping motor.

**UNIT – III**

**Variable Reluctance Stepping Motors:** Variable reluctance ( VR ) Stepper motors, single-stack VR step motors, Multiple stack VR motors-Open-loop control of 3-phase VR step motor-closed-Loop control of step motor, discriminator ( or rotor position sensor ) transilator, major loop-characteristics of step motor in open-loop drive – comparison between open-loop position control with step motor and a position control servo using a conventional ( dc or ac ) servo motor- Suitability and areas of application of stepper motors-5- phase hybrid stepping motor-single phase-stepper motor, the construction, operating principle torque developed in the motor.

**Switched Reluctance Motor:** Introduction – improvements in the design of conventional reluctance motors- Some distinctive differences between SR and conventional reluctance motors-principle of operation of SRM- Some design aspects of stator and rotor pole arcs, design of stator and rotor and pole arcs in SR motor-determination of  $L(\theta)$ ---  $\theta$  profile – power converter for SR motor-A numerical example –Rotor sensing mechanism and logic control, drive and power circuits, position sensing of rotor with Hall problems—derivation of torque expression, general linear case.

#### UNIT – IV

**Permanent Magnet Materials And Motors:** Introduction, Hysteresis loops and recoil line-stator frames (pole and yoke - part) of conventional PM dc Motors, Equivalent circuit of a PM-Development of Electronically commutated dc motor from conventional dc motor.

**Brushless DC Motor:** Types of construction – principle of operation of BLDM- sensing and switching logic scheme, sensing logic controller, lockout pulses –drive and power circuits, Base drive circuits, power converter circuit-Theoretical analysis and performance prediction, modeling and magnet circuit d-q analysis of BLDM -transient analysis formulation in terms of flux linkages as state variables-Approximate solution for current and torque under steady state –Theory of BLDM as variable speed synchronous motor ( assuming sinusoidal flux distribution )- Methods or reducing Torque Pulsations, 180 degrees pole arc and 120 degree current sheet.

#### UNIT – V

**Linear Induction Motor:** Development of a double-sided LIM from rotary type IM- A schematic of LIM drive for electric traction development of one-sided LIM with back iron-field analysis of a DSLIM fundamental assumptions.

#### TEXT BOOKS:

1. K. Venkataratnam, Special electrical machines, university press, 2009.
2. R. K. Rajput - Electrical machines, Laxmi Publications, 5<sup>th</sup> Edition 2016.
3. V.V. Athani - Stepper motor: Fundamentals, Applications and Design, New age International publishers, 1997.

#### REFERENCE BOOK:

1. “E. G. Janardanan”, Special electrical machines-PHI 2014.