

PCEL4302 **ELECTRICAL MACHINES-II** (3-1-0)

MODULE-I

[15 HOURS]

1. Three Phase Synchronous Generators (5 hours)

Synchronous Generator Construction (both Cylindrical Rotor and Salient Pole type), The Speed of Rotation of a Synchronous Generator, Induced voltage in A.C. Machines, The Internal Generated Voltage of a Synchronous Generator, The Effect of Coil Pitch on A.C. Machines, Distributed Windings in A.C. Machines, The Rotating Magnetic Field, The Equivalent Circuit of a Synchronous Generator (Armature Reaction Reactance, Synchronous Reactance and Impedance).

[Chapman: Ch. 5.1, 5.2, 4.4, 5.3, B.1, B.2, 4.2, 5.4]

2. Cylindrical Rotor type Three Phase Synchronous Generators (4+2=6 hours)

(a) The Phasor Diagram of a Synchronous Generator, Power and Torque in Synchronous Generators (Power Angle Equation and Power Angle Characteristic), Measuring Synchronous Generator Model Parameters (Open Circuit and Short Circuit Tests and Determination of Synchronous Impedance and Reactance, The Short Circuit Ratio), Voltage Regulation and Speed Regulation. **[Chapman: Ch. 5.5, 5.6, 5.7, 4.8] (4 hours)**

(b) Zero Power Factor characteristic, Potier Reactance, Voltage Regulation by Synchronous Impedance Method, Potier Reactance (Zero Power Factor = ZPF) Method. **[M.G.Say: Selected Portions of Ch.10.2, 10.3, 10.4, 10.15] (2 hours)**

3. Salient Pole type Three Phase Synchronous Generators (3+1=4 hours)

Two Reaction Concept, Development of the Equivalent Circuit of a Salient Pole type Three Phase Synchronous Generator (Direct axis and Quadrature axis Reactances, Phasor Diagram for various load power factors, Torque and Power Equations of Salient Pole Synchronous Generator (Power Angle Equation and Power Angle Characteristic with stator resistance neglected). **[Chapman: Appendix C.1, C.2] (3 hours)**

Slip Test for determination of Direct axis and Quadrature axis Reactances.

[M.G.Say: Ch.10.15]

(1hour)

MODULE-II

[12 HOURS]

4. Parallel operation of Three Phase A.C. Synchronous Generators (4 hours)

The Conditions Required for Paralleling, The General Procedure for Paralleling Generators, Frequency - Real Power and Voltage – Reactive Power Characteristics of a Three Phase Synchronous Generator, Operation of Generators in Parallel with large Power Systems, Operation of generators in parallel with other Generators of the same size. **[Chapman: Ch.5.9]**

5. Three Phase Synchronous Motors

(8 hours)

Basic Principles of Motor operation, Steady State Synchronous Motor operation, Starting Synchronous Motors, Synchronous Generators and Synchronous Motors, Synchronous Motor Ratings. **[Chapman: Ch.6.1, 6.2, 6.3, 6.4, 6.5]**

MODULE-III

[13 HOURS]

6. Three Phase Transformers (5+3=8 hours)

Constructional features, Three-Phase Transformer connections, The per unit system for Three Phase Transformer, Transformer Ratings and Related problems, Two Single-Phase Transformers connected in Open Delta (V-Connection) and their rating, T-Connection (Scott Connection) of Two Single-Phase Transformers to convert Three-Phase balanced supply to Two-Phase balanced supply. **[Chapman: Ch.2.10, 2.11, 2.12] (5 hours)**

Transformer Three phase Connections: Various Phase Displacements (0° , 180° , $+30^\circ$ and -30°), Connection Diagrams and Phasor Diagrams of various Vector Groups (Yy0, Dd0, Dz0, Yy6, Dd6, Dz6, Yd1, Dy1, Yz1, Yd11, Dy11, Yz11), Parallel operation of three phase transformers. **[M.G.Say: Ch.5.9, 5.15] (3 hours)**

7. Single Phase and Special Purpose Motors (5 hours)

The Universal Motor, Introduction to Single Phase Induction Motors, Starting of Single Phase Induction Motors, Speed Control of Single Phase Induction Motors, The Circuit Model of a Single Phase Induction Motor, Other types of Motors: Reluctance Motors, Stepper Motors. **[Chapman: Ch.10.1, 10.2, 10.3, 10.4, 10.5, 10.6]**

TEXT BOOKS:

- (1) Stephen J. Chapman-'Electric Machinery and Fundamentals'- McGraw Hill International Edition, (Fourth Edition), 2005.
- (2) M.G.Say-'Alternating Current Machines', English Language Book Society (ELBS) /Longman, 5th Edition, Reprinted 1990.

REFERENCE BOOKS:

- (1) P.C.Sen-'Principles of Electric Machines and Power Electronics'-2nd Edition, John Wiley and Sons, Wiley India Reprint, 2007.
- (2) B.S.Guru & H.R.Hiziroglu-'Electric Machinery & Transformers'-3rd Ed-Oxford Press, 2010.