

Physics of Electrical Machines
DSE (Electronics) Sem IV
(For Physics and Electronics as core subjects)

Credit: 04 (Theory-03, Practical-01)

(Credits: Theory-03, Practicals-01)

Theory Lectures 45

Unit- 1 **DC Machines:**

(18 Lectures)

Basic constructional features and physical principles involved in electrical machines, armature winding (ac and dc), lap and wave connections, different types of pitches

D.C. Generators:

Construction and principles of operation of dc generator, brief idea about armature action and commutation, E.M.F. Equation, Characteristics of Separately and Self excited (Shunt, Compound and Series) generators, Losses and efficiency, applications.

D.C. Motors:

Comparison of generator and motor action & interchangeability, principle of operation, significance of back EMF, maximum power, Torque and speed relation, Characteristics of series, shunt and Compound excited motors & applications, losses & efficiency, necessity of motor starters, Three point starter, Speed control of DC motors, electronic speed control of DC motors, electric braking

Unit-2 **Transformers:**

(15 Lectures)

Types of transformers, Transformer Construction, EMF equation, No load operation, operation under load, Phasor diagram, equivalent circuit of transformer, Transformer Losses, Voltage regulation, condition for maximum efficiency, All day efficiency, Short circuit and open circuit tests, Auto transformers. Three phase transformers, line and phase relations for Y-Y, delta-delta, delta –Y and Y-delta connection

Unit- 3 **Induction Motors**

(12 Lectures)

Uniform and oscillating magnetic field production using Helmholtz's coil, Rotating magnetic field (Ferrari's Principle), Three Phase Induction Motors: General constructional features, Types of rotors, Induction motor as a generalized transformer, equivalent circuit, Production of torque, Slip, Torque equation, Torque-slip characteristics, Speed control of Induction motor. Comparison with DC motor

Single Phase Motors: Single phase induction motors, Construction, principle of operation based on starting methods, Split phase motors, capacitor start motors, capacitor start & run motors, Reluctance Motor, Stepper Motor, Single phase a.c. series motors, Universal motor.

Suggested Books:

1. A. E. Fitzgerald, Charles Kingsley, Jr. and Stephen D. Umans, Electric Machinery, McGraw
2. I. J. Nagrath and D. P. Kothari, Electrical Machines, Tata McGraw Hill.
3. G. Mc. Pherson, An introduction to Electrical Machines & Transformers, John Wiley & Sons.
4. H. Cotton, Advanced Electrical Technology, CBS Publishers and Distributors, New Delhi.
5. S. Ghose, Electrical Machines, Pearson Education.
6. N. K. De and P. K. De, Electric Drives, Prentice Hall of India.
7. P. C. Sen, Principles of Electric Machines and Power Electronics, Wiley.
8. Abhijit Chakrabarti, Sudipt Rath and Chandan Kumar Chanda, Basic Electrical Engineering, Tata McGraw-Hill Publishing Company Limited New Delhi.

Physics of Electrical Machines Lab

1. Study of performance characteristics of DC Series motor by conducting load test.
2. Study of performance characteristics of DC Shunt motor by conducting load test.
3. Study of characteristics of single phase induction motor.
4. Study of characteristics of three phase induction motor.
5. Study of control of DC motor using SCR.
6. To perform Open Circuit Test and short circuit test on single phase transformer and find equivalent circuit parameters. Find the efficiency at various loads. Draw efficiency versus load curve. Find out the load at which is the maximum efficiency. Calculate the voltage regulation at full load, at power factor (i) 0.85 lagging and (ii) 0.85 leading.
7. To connect two single phase transformers in parallel and to obtain the data to study the load sharing of the transformers..
8. To connect three single phase transformers in various forms of three phase transformer connections and verify the voltage relationships.
9. To perform load test on a single phase transformer and determine (i) Polarity of primary and secondary Windings, (ii) Voltage ratio of transformer (iii) Voltage regulation of transformer.

Books:

1. N. K. Jain, A textbook of practicals in Electrical Engineering, Dhanpat Rai Publishing Company
2. S. G. Tarnekar et al, Laboratory courses in Electrical Engineering, S. Chand
3. S. K. Bhattacharya and K. M. Rastogi, Experiments in Basic Electrical Engineering, New Age International
4. T. Thyagrajan, Basic Electrical Engineering, Scitech Publications