2/4 B.Tech. FOURTH SEMESTER

EE4T2 ELECTRICAL MACHINES – II Credits: 3

Lecture: 3 periods/week Internal assessment: 30 marks

Tutorial: 1 period /week Semester end examination: 70 marks

Course Objective:

This is an extension of electrical machines- I course. This subject facilitates to study the performance of Transformers and Induction motors which play major role in power transmission, industrial drives and agricultural pump sets.

Course outcomes:

Upon completing of the course student should be

1. Able to understand construction, working principle, operating characteristics of single phase and 3 phase transformers and solve the problems for various parameters.
2. Able to understand the construction, working principle and characteristics of different types of motors and solve the problems for various parameters.
3. Able to understand double field theory, construction of single phase motor and their characteristics and industrial applications.

UNIT I

Single Phase Transformers: Principle of operation of transformer, constructional details of shell type and core type single-phase and three-phase transformers. EMF equation, operation of practical power transformer under no load and on load (with phasor diagrams). Concept of ideal transformers and commercial transformers.

Equivalent circuit, losses, efficiency, condition for maximum efficiency, all day efficiency. Open circuit and short circuit tests, calculating the parameters of equivalent circuit. regulation, predetermination of efficiency and regulation. Polarity test, Sumpner's test.

UNIT II

Parallel operation of Single Phase Transformers: Need, conditions to be satisfied for parallel operation. Load sharing in case of similar and dissimilar transformers. Auto-transformers (single and three phase)-construction, principle of operation, copper efficiency, merits and de-merits and their applications.

Three Phase Transformers: Introduction, choice between single unit three-phase transformer and bank of single-phase transformers. Transformers connection for three-phase operation-star/star, delta/delta, zigzag/star and vee/vee, choice of connection, phase shift between primary and secondary and vector groups. Scott connection for three-phase to two-phase conversion and its applications. Conditions for parallel operation of three –phase transformers, load sharing, ON load and OFF load tap changers.

UNIT III

Three phase Induction motors: Concept of rotating magnetic field. Principle of operation, construction of stator windings, squirrel-cage &slip-ring rotors. Slip, torque-slip characteristics covering motoring, generating and braking regions of operation, maximum torque, double cage and deep bar rotors. Equivalent circuit and performance evaluation of double cage induction motor. Phasor diagram of induction motor on no-load and on load. Equivalent circuit,

Induction generator- operation of induction generator – self exited and externally exited generators and its Applications

UNIT IV

Testing of three-phase Induction Motor: Losses in three phase induction motor efficiency, no-load and blocked rotor tests. Circle diagram and performance evaluation of motor. cogging and crawling.

Starting methods of Induction Motors: Need for starter. Direct on line (DOL), star-delta and autotransformer starting. Rotor resistance starting, modern methods – introduction to soft starters, principle of induction generator and its industrial applications.

Speed Control of Three-phase Induction Motors: Speed control-voltage, frequency, and rotor resistance, pole changing and cascading of motors, introduction to solid state controllers.

UNIT V

Single Phase Induction Motor: Classification of single phase induction motors – double revolving field theory – working principle of single winding single phase induction motor – cross field theory – equivalent circuit – power developed – construction, working principle – speed torque characteristics - spilt phase capacitor start motor, capacitor start capacitor run motor - shaded pole motor, ratings and their applications –equivalent circuit – testing of motors – efficiency – no load and blocked rotor tests.

Learning Resources

Text Books:

1. Electrical Machines by P.S.Bhimbra, Khanna publishers
2. Electrical Machines by J.B.Gupta, Kataria publications
3. Electrical Machines (AC) by Ashfaq Husain, Dhanpat Rai & Co.
4. Electrical Machinery by A.E. Fitzgerald, C. Kingsley and S. Umans, Mc Graw Hill Companies, 5th edition, 1990.

Reference Books:

1. Performance and design of A.C machines by MG Say, BPB publishers.
2. Theory of Alternating Current Machinery by Langsdorf, Tata Mc Graw Hill, 2nd edition.
3. Electrical Machines by I.J.Nagrath &D.P.Kothari, Tata Mc Graw - Hill publishers.