EE-301: Transformer and Induction Machine

Credit	L	T	P
3	2	1	-

UNIT I

TRANSFORMER: General constructional features of transformers, types of transformers, e.m.f. equation, working principle. Voltage, current and impedance relationships. Phasor diagram on no-load and full-load. Exact and approximate equivalent circuits. Open circuit and short circuit tests. Per-unit representation. Voltage regulation, conditions for maximum regulation, zero regulation and minimum regulation. Significance of voltage regulation in power and distribution transformers.

UNIT II

TRANSFORMER: Losses and efficiency, condition for maximum efficiency. Efficiency consideration in power and distribution transformers. All-day efficiency. Phasing out in three-phase transformer units. Polarity test. Single-phase transformers connected as three-phase bank. Comparison of 3-phase unit with 3-phase bank. Star/star, delta/delta, star/delta, delta/star and open delta connections. 3-phase to 2-phase and 3-phase to 6-phase conversions. Need and conditions for parallel operation, load sharing with equal and unequal voltage ratios, effect of per-unit impedance and X/R ratio, proportional load sharing.

UNIT III

TRANSFORMER: Principle of working and comparison of autotransformer with two-winding transformer. Advantages of tertiary winding in a three-winding transformer. Harmonics and magnetizing inrush in transformer.

3-PHASE INDUCTION MOTOR: General constructional features. Qualitative description of working of 3-phase induction motor from rotating field viewpoint. Stator fed and rotor fed induction motor. Steady state analysis: Equivalent circuit, phasor diagram, power flow diagram. Steinmetz IEEE equivalent circuit.

UNIT IV

3-PHASE INDUCTION MOTOR: Thevenin's equivalent model, torque-speed equation and characteristic, motoring, generating and braking regions, starting torque, maximum torque. Concept of leakage reactance and its importance in machine performance and design. Effect of rotor resistance on performance of induction motor. Deep-bar rotor and double-cage rotor. Starting, speed control and braking.

UNIT V

3-PHASE INDUCTION MOTOR: No-load and blocked-rotor tests, circle diagram, prediction of performance by circle diagram. Effect of space harmonics and time harmonics, crawling and cogging. Open, semi-closed, closed slots and their effect on motor performance.

SINGLE PHASE INDUCTION MOTOR: Double revolving field theory, principle of operation based on double revolving field theory, forward torque and backward torque, torque-speed characteristic. Equivalent circuit based on double revolving theory. Starting methods: Resistance-start split-phase, capacitor-start, capacitor-run, 2-value capacitor type motors, shaded pole motor, characteristics and applications.

TEXT/REFERENCE BOOKS.

1. I.J. Nagrath and D.P. Kothari, "Electrical Machines", Tata McGraw Hill, New Delhi.
2. Ashfaq Husain, "Electric Machines", Dhanpat Rai & Co.
3. George McPherson, "An Introduction to Electric Machine and Transformers", John Wiley, New York.
4. A.E. Fitzgerald, C. Kingsley and S.D. Umans, "Electric Machinery", Tata McGraw Hill, New Delhi.