**Electrical Machine**

Course Objectives:
To impart knowledge on constructional details, operating principle and performance of Transformers, DC Machines, and 3-phase Induction Machines.

1. Magnetic Circuits and Induction(4 hours)
    a. Magnetic Circuits: Series and Parallel Magnetic Circuits
    b. Core with air gap
    c. B-H relationship (Magnetization Characteristics)
    d. Hysteresis with DC and AC excitation
    e. Hysteresis Loss and Eddy Current Loss
    f. Faraday's Law of Electromagnetic Induction, Statically and Dynamically Induced EMF
    g. Force on Current Carrying Conductor

- 2. Transformer(12 hours)
    a. Constructional Details, recent trends
    b. Working principle and EMF equation
    c. Ideal Transformer
    d. Mutual Inductance and Coupled Circuit model
    e. No load and Load operation
    f. Equivalent Circuits and Phasor Diagram
    g. Capacity of Transformers
    h. Exciting Current harmonics
    i. Transformer Inrush Current
    j. Tests: Polarity Test, Open Circuit Test, Short Circuit test
    k. Voltage Regulation
    l. Losses in a Transformer
    m. Efficiency, condition for maximum efficiency and all day efficiency
    n. Instrument Transformers: Potential Transformer (PT) and Current Transformer(CT)
    o. Auto transformer: construction, working principle and Cu saving
    p. Three phase Transformers
    q. Three phase transformer connections: Y/Y, Y/Δ, Δ/Y, Δ/Δ and V/V (or open Δ)connections
    r. Choice between star and delta connection, Choice of Transformer connections
    s. Three phase to two phase conversion: Scott connection
    t. Three winding Transformer
    u. Parallel operation of single phase and three phase Transformers

- 3. DC Generator(7 hours)
    a. Constructional Details and Armature Windings
    b. Working principle and Commutator Action
    c. EMF equation
    d. Method of excitation: separately and self excited, Types of DC Generator
    e. Characteristics of series, shunt and compound generator
    f. Voltage build up in a self excited DC generator
    g. Armature Reaction
    h. Commutation: Interpoles and Compensating Windings
    i. Losses in DC generators
    j. Efficiency and Voltage Regulation

4. DC Motor(7 hours)
    a. Working principle and Torque equation
    b. Back EMF
    c. Method of excitation, Types of DC Motor
    d. Performance Characteristics of D.C. motors
    e. Losses and Efficiency
    f. Starting of D.C. Motors: 3 point and 4 point starters
    g. Speed control of D.C. Motors: Field Control, Armature Control, Reversing of DC Motors

5. Three-Phase Induction Machines(12 hours)
    a. Three Phase Induction Motor
    b. Constructional Details and Types
    c. Operating Principle, Rotating Magnetic Field, Synchronous Speed,
    d. Slip, Induced EMF, Rotor Current and its frequency, Torque Equation
    e. Torque-Slip characteristics, Effect of rotor resistance on Torque-Slip characteristics
    f. Testing of Induction Motor
    g. Losses, Power stages and Efficiency
    h. Starting Methods
    i. Speed Control Methods
    j. Double Cage Induction Motor
    k. Three Phase Induction Generator
        i. Working Principle, voltage build up in an Induction Generator
        ii. Power Stages
        iii. Isolated and Grid connected mode

References:


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6. Irving L.Kosow, "Electric Machine and Tranformers", Prentice Hall of India.
7. M.G. Say, "The Performance and Design of AC machines", Pit man & Sons.
8. Bhag S. Guru and Huseyin R. Hizirogulu, "Electric Machinery and Transformers"
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