ELECTRICAL MACHINES I

UNIT I - ELECTROMECHANICAL ENERGY CONVERSION

Introduction - Law of Electromagnetism, Energy flow in Electromechanical energy conversion device. **Magnetic system -** Types of magnetic system, Singly excited magnetic system, Concept of co-energy, Mechanical force, Direction of mechanical force, Mechanical energy. **Problems based on single excited magnetic system -** Problems based on magnetic system , Comparision between lap winding and wind winding. **Multiple excited magnetic system -** Multiple excited magnetic system, Problem based on multiple excited magnetic system. **Energy conversion via electric field -** Analysis of energy conversion, Co-energy calculations.

UNIT II - UNIT 2 D.C. GENERATOR AND ARMATURE REACTION

D.C. Generator construction - Introduction, Construction of D.C. generator, Magnetic frame or yoke, Pole cores and pole shoes, Pole coils, Armature, Commutator, Brushes, Bearings, End covers or end housings, Shaft and Pulley. **Working principle of D.C. generator -** Working operation of simple loop generator, Working principle of D.C. generator. **Lap and wave winding -** Armature windings, Terms used in armature winding, Coil or winding element, Terms used in armature winding, Type of D.C. armature windings, Comparison between lap and wave winding. **Design of armature winding -** Simplex lap-winding, Simplex wave winding. **EMF Equation** - E.M.F. equation of D.C. generator, Problem based on E.M.F equation of d.c. generator. **Armature reaction -** Armature reaction, Demagnetising and cross-magnetising conductors, Demagnetising AT per pole, Cross-Magnetising AT per pole, Compensating windings. **Problems -** Problem based on demagnetising and cross magnetising of pole. **Commutation -** Action of commutator, Commutation, Expression for reactance voltage, Problem based on reactance voltage. **Methods of improving commutation -** E.M.F. commutation, Equalizing connections. **Powerflow diagrams -** Power stages in D.C. generator, Types of generator efficiencies.

UNIT III - TYPES OF D.C. GENERATOR AND LOAD CHARACTERISTICS

Types of generators - What do you mean by excitation ?, Classification of D.C. generators, Types of D.C. generator, Series generator, Problem based on d.c. series generator. **Types of D.C. generators -** D.C. shunt generators, Problem based on d.c. shunt generator, Compound generator, Problem based on compound generator. **Condition for building up and non-building up of EMF -** Residual magnetism, Conditions for non-building up of E.M.F. in D.C. generator, Causes fo failure to excite self excited generator. **Calculation of critical field resistance and critical speed -** Critical field resistance and critical speed, Critical resistance for shunt generator, Calculation of critical speed, Problem based on critical field resistance and critical speed. **Characteristics of D.C. generators -** Load Characteristics D.C. Generators, Load characteristics of D.C. Shunt Generator, Load characteristics of D.C. Series Generator, Load Characteristics D.C. Compound Generators. **Applications of D.C. generators** - Applications of D.C. generators. **Necessity of parallel operation** - Conditions necessary for parallel operation. **Conditions**

for parallel operation of D.C. generators - Paralleling D.C. generator, Load sharing, Procedure for paralleling D.C. generator, Problem based on parallel operation of D.C. generators. **Use of equalizer ring in parallel operation and applications of D.C. generators -** Compound generator in parallel, problem based on compound generator in parallel, Series generator in parallel, Problem based on series generator in parallel.

UNIT IV - D.C. MOTORS AND SPEED CONTROL METHODS

Working principle of D.C. Motor - Working of D.C. motor. **Back e.m.f** - Signification of the back E.M.F, Importance of back E.M.F. **Torque and speed equation** - Torque equation, Speed-torque equation, Problems based on motor torque and speed. **Types of D.C. motor -** Classification of D.C. motor, D.C. series motor, Problem based on d.c. series motor, D.C. shunt motor, Problem based on d.c. shunt motor, D.C. compound motor. **Characteristics** - D.C. Motor characteristics, Characteristics of D.C. shunt motor, Characteristics of D.C. series motor, Characteristics of D.C. compound motor, Application of D.C. motor. **Effect of armature reaction on performance of a D.C. motor** - Effect of armature reaction on performance of a D.C. motor. **Speed control** - Necessity of speed control, Methods of speed control, Armature control (or) Rheostatic control method, Voltage control method, Problem based on speed control of dc shunt motor. **Speed control of series motor -** Problem based on speed control of dc series motor. **Starter** - Necessity of starter, Three point starter, Function of no volt coil, Action of over load release, Speed control, Four point starter, Necessity of the starter for d.c. series motor, Drum controlled starter. **Braking and it's applications** - Electric braking, Plugging, Rheostatic braking (Dynamic braking), Regenerative braking, Comparison of Plugging, Regenerative and Rheostatic braking methods, Characteristics of D.C.compound motors, Differential D.C.compound motors. **Permanent magnet dc motor -** Permanent magnet D.C. motor.

UNIT V - TESTING OF D.C. MACHINES

Introduction - Losses in a D.C. machine. **Efficiency of D.C. machine -** Types of generator efficiencies, Problems based on efficiency. **Testing of motors** - Testing of d.c. motors, Brake test on d.c. shunt motor, Brake test on d.c. series motor, Brake test on d.c. cumulative compound motor, Swinburne's test, Advantage and disadvantage, Regenerative or Hopkinson's test (back-to-back test), Methods of procedure, Alternative connections for Hopkinson's test, Merits of Hopkinson's test, Problem based on testing of dc motor, Retardation or Running down test, Field's Test For Series Motor. **Separation of No load losses of D.C. Machines -** Separation of No load losses of D.C. Machines, Problem based on separation of no load losses.