

SYLLABUS - DIPLOMA IN ELECTRICAL ENGINEERING

1) Fundamentals of Electrical and Electronics Engineering

Electric Circuits and Networks: Electricity - definitions and units - current - voltage - resistance - power - ohm's law - DC & AC circuits comparison between series and parallel circuits. Fundamentals of AC systems electromagnetic induction Faraday's laws of electromagnetic induction reactance impedance. Magnetism - concepts of magnetic flux - Electromagnetism - Faraday's laws - Lenz's law - comparison of electric and magnetic circuits. Static electricity Laws of electrostatics - Capacitors - Charging and discharging - Energy stored.

Types of network and parameters - Network theorems - Kirchoff's law Superposition Theorem - Thevenin's and Norton's Theorems. Heating effect of Electric current - Joules law. AC through pure R, L, C and combinations of R, L, & C - series and parallel circuits. Phasor and impedance diagrams - power factor various powers active power reactive power apparent power. Resonance in R-L-C series and parallel circuits. Generation of three-phase AC voltages waveforms - phase sequence advantages of three-phase systems. Three - phase Interconnections - star - delta.

II)Measurements, Switchgear & Protection

Electrical & Electronic Measurements: Methods of measurements - Direct - Indirect. Classification of instruments absolute and secondary analog and digital null and deflection type instruments indicating - integrating - recording. Measurement of resistance inductance and capacitance. Special purpose measuring instruments Dynamometer type power factor meter synchroscope - Phase sequence indicators Frequency meter Earth tester Insulation tester. Digital meters digital voltmeter Digital frequency meter Smart energy meters Waveform analysers. Transducers - Thermocouple Thermistors - Digital tachometers DC and AC tacho generators.

Switch Gear & Protection: Necessity - Current limiting reactors Fuses - HRC fuses. Circuit breakers - Arcing - Arc extinction. Oil-Air blast Vacuum and SF6 Circuit Breakers. Isolators Protective relays. Electromagnetic relays - Distance and differential protection - Static relay. Faults in Electrical Machines - Important faults in Alternators, Transformers, and Electric motors. Differential protection - Merz price scheme - Earth fault - Buchholz relay - earth fault leakage protection - combined leakage and overload protection. Short circuit protection and overload protection for motors.

III) Electronics Engineering

Electronic components Active and passive components, resistors, capacitors, and inductors: PN junction Diode rectifier circuits Transistors. Multistage transistors Power amplifiers - Push pull amplifiers - Oscillators - Operational amplifiers - Applications of Op amp - Comparators. Number systems Logic gates, Demorgan's theorems. Combinational logic circuits - Flip flop - synchronous and asynchronous counters. **Power Electronic Devices-** MOSFET, IGBT, GTO, LASCR, SCS, UJT, DIAC, TRIAC, and SCR - Bridge rectifier. DC Chopper - Types of choppers. Inverter - concept of CSI and VSI - Bridge inverters. Principle of pulse width modulation - single PWM - sinusoidal PWM SMPS.

IV) Electrical Installation Design & Estimation:

Service connection - Basic requirements for electric connection - calculation of monthly electricity bill. Electrical Lamps - Electric Heating. Electrical safety - important safety precautions.

Relevant Indian Standards and CEA Regulations used for internal wiring, illumination and earthing. Various wiring methods - Light and Power circuits. - Switchboards - Main switchboard - Distribution board - Selection of cables for internal wiring. Estimation of domestic Installations. Recommended levels of illumination for various places. Lamps and luminaries - luminous flux of various lamps - life span. Design of lighting schemes for domestic buildings street lighting - flood lighting. IE rules regarding earthing systems - pipe earthing and plate earthing. Estimation of Industrial Installations. Estimation of

Pump Sets. Service connection - cables for service connections - estimation and costing of service overhead and underground service connections - single phase and three phase.

V) Electrical Machines

DC generator - EMF equation-losses-power stages-efficiency - armature winding - lap and wave windings. Armature reaction-commutation - interpoles equalizer connections. Separately uses of DC generators. self-excited generators critical speed DC motor: Significance of back emf-torque torque equation armature torque and shaft torque losses power stages efficiency applications. Speed control of DC motor. Induction Machines: Single phase and Three phase transformers working principle - equivalent circuit of a transformer - No load and Load characteristics-efficiency and regulation- all day efficiency-Autotransformers and Instrument Transformers. Single Phase and Three-phase induction motors -Slip ring and Squirrel cage rotors - Speed-Slip frequency-Crawling-Cogging. Starting various starters - Speed control Braking. Double cage induction motor. Commutator motors AC series motor universal motor repulsion motor Stepper motor. Synchronous Generators: Working principle types of armature windings - salient and cylindrical type rotors - damper winding. Alternator on load -Armature reaction - Synchronous reactance & impedance. Regulation Power Losses and efficiency Parallel operation Conditions of Synchronization of three phase alternators. Synchronous motor -Starting methods Different torques Hunting. Induction motors Synchronous condensers. Working principle Losses and power flow Comparison between Synchronous and Electric Traction motors Electrical braking in traction - rheostatic braking regenerative braking.

Electric Vehicles (EV): Benefits of EVs including environmental impacts Pure Electric vehicle (PE)-Battery Electric vehicles (BEV) - Fuel Cell Electric Vehicles (FCEV) - Hybrid Electric vehicle (HEV) - Plug-in Hybrid Electric vehicle (PHEV). Energy storage technologies - speed variation in EV-ultra-capacitors, ultra-flywheels, and fuel cells batteries - Lead Acid Battery - Nickel batteries - Lithium batteries - Fuel Cell-Super Capacitor - Super Flywheel based energy storage - Hybridization of different energy storage devices. Battery charging Technologies Methods of charging Domestic Charging Infrastructure -Public

Charging Infrastructure - Fast Charging Station - Battery Swapping Station - Effect of EV charging on generation and load profile - Smart charging technologies-Centralized and Decentralised charging schemes Energy storage integration into Microgrid - Repairing and rectifying faults in EV motor and components - EV battery and battery management systems - EV charging device repairing - Battery disposal & recycling.

VI) Energy Sources and Management

Renewable Energy: Energy sources conventional non conventional need of renewable energy Hydel Power Geothermal Vapour dominated Bio-Energy. Solar energy solar radiation- solar irradiation- solar insolation. Solar collectors Solar cell Photovoltaic effect important factors considered for installing a solar panel-direction-tilt-shading-temperature - Roof top-Standalone-Grid connected Power converters in PV system- Buck converter - Boost converter - battery and inverter for a given backup time. Wind energy conversion systems - turbines. Tidal Power - Ocean energy conversion systems. Hydrogen and Oxygen fuel cells-- differences between battery and fuel cells.

Energy Conservation, Management & Audit: Energy Scenario: Current global energy scenario, coal, oil, and natural gas reserve statistical data energy consumption in Industrial, Agriculture and Residential sectors in India. Energy conservation and its importance - energy efficiency and its benefits Schemes of BEE under the Energy Conservation Act-2001 Energy Conservation Building Codes Energy Conservation through Cogeneration. Energy Management Energy saving techniques in lighting systems, motors, and Transformers. Energy efficient transformers - Amorphous transformers -Soft starters - Automatic star delta converter Variable Frequency Drives - Automatic Power Factor Controller (APFC) - Intelligent Power Factor Controller (IPFC). Energy Audit BEE - Standards and labelling demand side management - promoting energy efficiency in small and medium enterprises-designated consumers - certification of Energy Auditors and Energy Managers.