



LEARNING RESOURCES In Electrical Engineering

Content List

Kunal IT Services Pvt. Ltd.
925/A, Trikaya House, Deendayal Hospital Lane
F.C. Road, Pune-411005
Maharashtra, India

Kunal IT Services (P) Ltd. is a Pune based Firm specializing in the Design, Development of the Education Contents for the Engineering Degree courses. We have developed CAI/ LRs in Electrical / Electronics Engineering for the subjects mentioned below, which are useful to both Teachers and Students.

Electrical / Electronics Engineering Learning Resources

- Elements of Electrical Engg
- Electrical Engineering Materials
- Electrical Engineering Drawing
- Electrical Machine
- Electrical Power System
- Electrical Measurements & Instruments
- Electrical Circuits
- Switchgear & Protection
- Electrical & Illumination Design
- Repair of Electrical Machine

Technically Complete Content

Subject	Theory Pages	Figures	Animations	Video Clips
Elements of Electrical Engg	√	√	√	√
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Switchgear & Protection	√	√	√	
Electrical & Illumination Design	√	√	√	
Repair of Electrical Machine	√	√	√	

Elements of Electrical Engineering

Chapter	Topics
Ch-1 Basic concepts of electrical engineering	Structure of an atom, Recalling concept of V, R, & I., Ohm's law, Concept of current (D.C. /A.C.), Effects of an electric current, Concept of voltage, Concept of resistance, Laws of resistance, Specific Resistance or resistivity, Conductance & specific conductance, Conductor semiconductor & insulator.
Ch-2 Sources of electrical energy	Electrical energy applications, Energy sources, Fossil fuels, Water, Nuclear fuels, Sun, wind, Ocean tides & Wave, Geothermal sources, Introduction to supply system, Single phase & three phase system, Star & delta connection, Comparison of star & delta connection, Comparison of single phase & 3 phases.
CH-3 Storage batteries	Faraday's law of electrolysis, Lead acid battery, Plante process, Faure process, Internal resistance and capacity of a cell, Electrical characteristics of the lead acid cell, Voltage regulators, End-cell control system, Constant-current system, Constant-voltage system, Alkaline batteries, Nickel-iron or Edison batteries, Nickel-cadmium batteries, Silver-zinc batteries.
Ch-4 Electrical circuit components	Commonly used wiring components, Wire, Lamp holder, Switches, Ceiling rose, Plugs & sockets, Distribution box, Fuses > Rewirable, HRC, Connector blocks, Adaptors.
Ch-5 Types of electrical circuits	Series circuit of resistors, Parallel circuit of resistors, Current & voltage distribution, Kirchhoff's laws, Application of Kirchhoff's laws, Star delta & delta star transformation.
Ch-6 Electrostatics	Laws of electrostatics, Concept of capacitor formation, Capacitance, Types of capacitor, Definitions, Permittivity, Capacitance of parallel plate capacitor, Capacitors in series, Capacitors in parallel.
Ch-7 Capacitors	Energy stored in a capacitor, Charging of a capacitor, Discharging of a capacitor.
Ch-8 Magnetic circuits	Review of concept of magnetism, Permeability, Concept of electromagnetism, Magnetic circuits, Magnetic leakage, leakage coefficient, Series magnetic circuits, Parallel magnetic circuits.
Ch-9 Electromagnetism	Field due to current carrying straight Conductor, Rules-indicating the direction of field, MMF & magnetic field strength of a long straight conductor, Solenoid, Force on a current carrying conductor, Magnetization curve, Concept of hysteresis & hysteresis loss, Lifting magnets & applications.
Ch-10 Electromagnetic induction	Faraday's laws of electromagnetic induction, Types of induced emf, Rise & decay of current in an inductive circuit, Mathematical expression for current at any instant during its decay in an inductive circuit, Mutually induced emf, Inductances in series, Inductances in parallel.
CH-11 AC Fundamentals	Generation of alternating current & voltage, Difference between AC & DC, Some important terms, Equations of alternating voltages & currents, RMS value of sinusoidal current or voltages, Average value of sinusoidal current or voltage, Peak factor & form factor, Phasor representation of alternating quantities.
CH-12 AC circuits	Purely resistive AC circuit, Purely inductive AC circuit- inductive reactance, Purely capacitive AC circuit- capacitive reactance, AC series circuits, AC circuit with resistance & inductance in series, AC circuit with resistance & capacitance in series, AC circuit with resistance, inductance & capacitance in series.

CH-13 Three phase circuit	Polyphase systems & their advantages, Generation of three phase voltages, Three phase supply systems, Balanced load, Balanced system; Voltage, current & power relations in a star connection, Voltage, current & power relations in a delta connection; Apparent power & reactive power, Applications of star & delta connections.
Ch-14 Domestic Appliances	Classification, Heating appliances, Water heater, Electric segari or stove, Electric irons, Electric bells.

Electrical Measurements & Instruments

Ch-1 Introduction-Units	Unit, Fundamental and derived units, Dimensions, Dimensions of Mechanical Quantities, CGS System of Units, Electromagnetic Units, Electrostatic Units, Practical Units, M.K.S. System.
Ch-2 Types of Instruments	Basic Block Diagram and their Function, Need of Measurement, Methods of Measurements, Measurement terms, Errors, Types of Instrumentation Systems, Types of Errors. Classification of Instruments Mechanical, Electrical, Electronic Instruments. Classification of instruments according to standardization Absolute instruments, Secondary instruments. Necessity of different torques A deflecting (or operating) torque, A controlling (or restoring) torque, A damping torque. Methods of Damping Air friction or pneumatic damping, Eddy current or electromagnetic damping, Fluid friction damping.
Ch-3 Construction and Working Principles	Permanent Magnet Moving-Coil Instrument, Moving-iron Instruments, Dynamometer type (or Electrodynamics), Moving Coil Instrument, Instrument Transformers- Current transformer (C.T.), Potential transformer (P.T.).
Ch-4 Extension of Range of Instruments & Conversion.	P.M.M.C. Type instrument, M.I. Type instrument, Dynamometer Type instrument.
Ch-5 Measurement of Resistance	Classification Of Resistance, Measurement of Medium Resistance, Ammeter-Voltmeter Method, Substitution method, Wheatstone Bridge, Method For measurement of low Resistance, Kelvin Bridge, Kelvin Double Bridge, Meggers, Earth tester & measurement of earth resistance.
Ch-6 Measurement of power	Power in A.C. circuit, Principle construction and operation of Electrodynamic Wattmeter, Errors in wattmeter & their compensation, Three phase wattmeters, Measurement of power in three phase systems, One wattmeter method, Two wattmeter method, Merits and demerits of two wattmeter method, Determination of power factor from wattmeter readings for balanced load.
Ch-7 Measurement of electrical energy	Single Phase Energy Meter, Induction Type Three-Phase Energy Meters, Testing And Calibration of Energy Meters, Using a Substandard Electrodynamic Wattmeter, Using A Rotating Substandard Meter, Errors And Their Compensation in Induction-Type Energy Meters.
Ch-8 AC Bridges and potentiometers	Maxwell's Inductance Bridge, Maxwell's Inductance Capacitance Bridge, Hay's Bridge, Anderson's Bridge, Schering Bridge, De Sauty's Bridge, Owen's Bridge, Wien's Bridge, Universal Impedance Bridge, Potentiometers, A.C. Potentiometers.
Ch-9 To Describe the Transformer oil testing	Use of Insulating Oil, Method of Purifying and Drying of Transformer Oil, Sludge Resistance Test, Flash Point Test, Dielectric Strength of Transformer Oil

Ch-10 Basic Electronics Instruments	Multimeter – Introduction, DC Ammeters, DC Voltmeters, Voltmeter Sensitivity, Series Type Ohmmeter, Shunt Type Ohmmeter, Testing a Diode with a Multimeter, Testing a Transistor with a Multimeter.
Ch-11 Construction and principle of other meters	Single Phase Electrodynamometer®Power Factor Meter, Three Phase Electrodynamometer, Power Factor Meter, Frequency Meters, Ferrodynamic Type Frequency Meter, Weston Frequency Meter, Synchrosopes, Weston Type Synchroscope, Phase Sequence Indicators, Average Demand Indicator, (Merz Price Maximum Demand Indicator), Q-Meter

SwitchGear and Protection

Ch-1 Protective Relays	Zones of Protection, Electrical Quantities of Protection, Basic Principles of Operation, Methods of Discrimination, Derivation of a 1-phase Quantity, Components of Protection, Relay Classification, Electro Magnetic Relays, Definitions.
Ch-2 Relay Applications & Characteristics	General Equation of Comparators, General Equation for Electromagnetic Relays, Over Current Relays, Distance Relays, Differential Relays.
Ch-3 Instrument Transformers	Current Transformers, Potential Transformers.
Ch-4 Neutral Grounding	Effectively Grounded System, Ungrounded System, Solid Grounding or Effective Grounding, Resistance Grounding, Reactance Grounding, Resonant Grounding, Earthing Transformers, Generator Neutral Breakers, Grounding Practice.
Ch-5 Feeder Protection	Types of Protection and Their Selection, Overcurrent Protection, Distance Protection, Scheme of Distance Protection, Pilot Protection, Carrier Equipment, Carrier Circuits for Protection.
Ch-6 Apparatus Protection	Transformer Protection, Generator Protection, Motor Protection, Bus-zone Protection.
Ch-7 Auto Re-Closing	Definitions and Available Features, Auto-Reclosing, Medium Voltage Auto-Reclose, High Voltage Auto-Reclose, Three-phase Versus Single Phase Auto-Reclose.
Ch-8 Testing & Maintenance Protective Gear	Classification of Relay Testing, Test Benches, Heavy Current Test Plant, General Method of Testing Protective Gear, Current Transformer Tests, Potential Transformer Tests, Features of Design Which Assist Maintenance.
Ch-9 Static Relays	Classification of Static Relays, Basic Associated Circuits, Types of Amplitude Comparators, Types of Phase Comparators, Basic Elements of a Static Relay, Over Current Relays, Differential Relays, Distance Relays.
Ch-10 Microprocessor Based Relays	Advantages of Microprocessor-based Relays, Procedure for Developing Protection Scheme, Basic Protection Scheme, Microprocessor-based Overcurrent Relays, Microprocessor-based Distance Relays.
Ch-11 Fuses	Definitions, Fuse Characteristics, Types of Fuses, Semi-enclosed Rewirable Fuse, D-type Cartridge Fuse, High Rupturing Capacity (HRC) Cartridge Fuse, Expulsion Type High Voltage Fuse, Drop-out Fuse, Applications of HRC Fuses, Selection of Fuses, Test on Fuses.
Ch-12 Circuit Breakers	Functions of Circuit Breakers, Fault Clearing Process, Rating of Circuit Breakers, Air-Break Circuit Breakers, Oil Circuit Breakers, Air-Blast Circuit Breakers, SF6 Circuit Breakers, Vacuum Circuit Breakers, Operating Mechanism.
Ch-13 Over-voltage Protection	Causes of Over-voltages, Lightning Phenomena, Ground Wires, Horn Gap, Rod Gap, Lightning Arrester or Surge Diverter, Expulsion Type Lightning Arrester, Non-linear Surge Diverter, Metal Oxide Surge Arrester, Surge Absorber, Peterson Coil, Insulation Coordination.

Electrical Circuits

Ch 1 Electrical Circuit Elements	Overview of electrical circuit, Electrical Circuit, Ideal Voltage Source, Ideal Current Source, Resistance, Capacitance, Inductance, Mutual Inductance, Practical sources, Practical resistors, Practical capacitors, Practical Inductors.
Ch 2 D.C. Circuits	Kirchhoff's voltage law (KVL), Kirchhoff's current law (KCL), Resistance in series/parallel, Analysis by Series/ parallel equivalents, Thevenin's theorem, Norton's theorem, The superposition theorem, The star – delta transformation, The maximum power transfer theorem, Mesh Analysis, Nodal Analysis.
Ch 3 Magnetic Circuits	Magnetic fields, Ampere's Law, Magnetic Circuit, Analogy of the magnetic circuit, Leakage flux and fringing effect, B. H. curve, Magnetic Hysteresis, Hysteresis loop, Hysteresis loss.
Ch 4 Sinusoidally Excited Circuits	Sinusoidal Excitation, Element response- Resistance, Element response – Capacitance, Element response – Inductance, The series R. L. circuit, Phasor & Complex impedance, Thevenin's & Norton's equivalent, Nodal and Mesh Analysis, Transformations, Power & Power factor in AC Circuits, Maximum power Transfer,
Ch 5 Resonance	Introduction, Frequency response of simple circuits, Series Resonance, Parallel Resonance, Tank Circuit,
Ch 6 Transients	Transients in simple circuits, Laplace Transformation, Partial fraction Expansion, Transients in RLS circuits, The Special functions, Analysis by Laplace transformation.
Ch 7 Waveform Analysis	Fourier series, Waveform symmetry, Fourier analysis, Applications in Circuit Analysis.

Electrical Engineering Material

Ch 1 Classification of materials	Selection of materials, Classification of materials-Functionally, Classification based on atomic structure.
Ch 2 Materials for conductors & resistors	Resistivity, Conductor Materials: General Requirements, Conductor Materials: Properties & Applications, Resistor Materials: General Requirements, Resistor Materials: Properties & Application.
Ch 3 Dielectric materials	Dielectric properties, Electric conductivity & breakdown of dielectric, General properties & application of dielectric.
Ch 4 Insulating Materials	General properties of insulating materials, Classification of insulating materials, Impregnated fibrous material, Insulating liquids, Ceramics, Mica, Asbestos, Glass, Rubber.
Ch 5 Insulating materials for special purpose	Waxes, Adhesives, Enamels, Varnishes, Coolants.
Ch 6 Magnetic Materials	Magnetization, Classification of materials, Magnetic properties of the material, Soft magnetic materials, Hard magnetic materials.
Ch 7 Special purpose Materials & processes	Structural materials, Protective materials, Thermo couple, Bimetals, Soldering, Contract materials, Refractory materials, Fluorescent & phosphorescent materials, Galvanizing process, Impregnating process, Other process.
Ch 8 Plastics	Natural plastics, Synthetic plastics, Thermoplastics plastics, Thermo sets plastics.
CH 9 Semi conducting materials	Semi conductor- Intrinsic & extrinsic, current carriers; Semi- conductor materials- Classification, Applications, Merits.
CH 10 Materials for Electronic components	Resistors, Capacitors, Inductors, Transformers, Diodes, Transistors.

Electrical Machines – I

CH 1 Generalised treatment	Basic principles of a generator & motor, Torque due to alignment of two magnetic fields, Emf induced in a coil, Elementary concepts of an electrical machine, Difference between a generator & a motor.
Ch 2 D.C. Machines	Necessity of D.C. Machines, Different constructional parts of D.C. Machines and their function, Different materials used for constructional parts.
Ch 3 D.C. Generator	Working of a Generator, Different constructional parts and their functions, EMF equation, Armature reaction in DC generators, Commutation, Types of generators, Applications.
Ch 4 D.C. Motor	Principle, back emf. And Torque equation, Types of D.C. Motors, Principles of speed control of D.C. Motors, DC motor starters, Losses & Efficiency, Determination of efficiency, Characteristics of D.C. Motors, Applications.
Ch 5 Single Phase Transformer	Working Principle, Constructional Parts and their function, E.M.F. equation, Phasor diagram, Equivalent circuit diagram, Tests, Losses, efficiency and regulation, Types of transformer, Autotransformer, Testing of transformer.
Ch 6 Three Phase Transformer	Transformer connections, Parallel operation, Phase conversion, Tap changing transformer, Transformer cooling.

Electrical Machine-II

Ch-1 Induction Motor	Principle of Induction Motor, Production of rotating magnetic field, Constructional parts and their functions, Equation for rotor current, Torque equation, Development of circuit model, Determination of parameters & efficiency, Circle diagram, Classification of Induction motors, Starting & speed control of motors, Cogging & crawling, Applications, Testing of motor.
Ch-2 Synchronous Motor	Principle of operation, starting methods, Constructional parts and their Functions, 'V' and inverted 'V' curves, Applications, Comparison of Induction and Synchronous Motors.
Ch-3 Alternator	Principle and E.M.F. equation, Nature of armature reaction, Synchronous impedance, Voltage regulations, measurement of synchronous impedance, Types of Alternators, Operating characteristics, Parallel operations, Hunting or phase swinging, Cooling of alternator.
Ch 4 Single Phase Motor	<p>Repulsion Motor - Construction, Principle of Operation, Application.</p> <p>A.C. Series Motor - Construction, Working Principle, Drawbacks when D.C. Motor run on A.C., Application.</p> <p>Universal Motor - Speed control of universal motors, Application.</p> <p>Single phase synchronous motor Introduction, Reluctance motor, Hysteresis motor, Difference between reluctance & hysteresis motor.</p>
Ch 9 Special Machines	Step angle, Types of Stepper Motors, Permanent-Magnet DC Motor, Low-inertia DC motors, Printed-circuit (Disc) DC Motor, Permanent-Magnet Synchronous Motors, Synchros, Servomotors.S

Electrical Estimation & Illumination Design

Ch 1 Electrical Symbols & Standards	Electrical Diagrams, Wiring Diagrams, Circuit Diagrams or Schematic Diagram.
Ch 2 Lighting Installation	Protection of Electrical Installation, Earthing, Requirement of Electrical Installation, Testing of Installations. Systems of wiring, Service connections, Sub-Circuits, Guidelines for Installation of Fittings, Estimating & Costing.
Ch 3 Service Connections	Underground Service Connection, Overhead Service Connections, PVC or Weatherproof Cable Service Line, Bare Conductor service Line, Service Mains.
Ch 4 Estimation & Costing of Pole Mounted Substation	Types of Substations, Outdoor Substations - Pole Mounted, Earthing Arrangement, Solved Examples.
Ch 5 Automatic Starter Design	Introduction to AC Motors, Starting of 3-phase Squirrel Cage IM, Direct On-line Starting, Primary Resister or Reactor Starting, Star Delta Starting, Starting of Slip Ring Motors, Starting of Synchronous Motors, Contactor Control Circuit Components, Direct On-line Starting of IM, Remote Control Operation of an IM, Automatic Star Delta Starter.
Ch 6 Design & Drawing of Panel Boards	Types of Panel Boards, Dimensions of Electrical Accessories, Three Pin Socket Outlet, Flush Switch, Flush Socket, Fan Regulator, Design of Panel Board, Solved Examples.
Ch 7 Transformer Design	Theory of Transformer Design, Winding Design, Design of a Small Transformer, Making of Small Transformer
Ch 8 Design of Illumination Scheme	Terminology in Illumination, Reflection, Diffusion, Refraction, Design of Lighting Scheme, Lighting Sources, Practical Lighting Schemes, Lighting System Consideration for Different Occupancies, Design Consideration of a Good Lighting Scheme, Calculation of Illumination.

Electric Power System

Ch 1 Generation of Electrical Power	Sources of energy, Steam Power Station, Hydro-electric Power Station, Nuclear Power Station, Diesel power station, Gas turbine power station, Economics of power generation.
Ch 2 Power Planning Economics & Tariff	Cost of Electrical Energy, Expression for Cost of Electrical Energy, Method of Determining Depreciation, Mathematical Treatment, Importance of High Load Factor, Tariff, Power Factor Tariff, Methods of power factor improvement.
Ch 3 Power Installation & Drives	Requirements of Different Dimensions of Foundation, Factors to be Taken into Account in Designing Machine Foundations, Procedure for Leveling and Aligning, The Alignment of Direct-coupled Drive, Aligning Belts, Ropes, Chains and Gears, Location of Transformers, Requirements for Installing Pole Mounted Transformer, Requirements for Installing Bus-Bars.
Ch 4 Substation	Sub-station, Classification of Sub-stations, Comparison Between Outdoor and Indoor Sub-stations, Equipment of Steam Power Station, Pole Mounted Sub-stations, Underground Sub-station, Equipment in a Transformer Sub-station, Bus-bar Arrangement in Sub-stations, Terminal and Through Sub-stations, Key Diagram of 66/11 kV Sub-station, Key Diagram of 11 kV/ 400V Indoor Sub-station, Earthing.
Ch 5 Principles of Transmission & Distribution	Introduction, Distribution System, Classification of Distribution Systems, A.C. Distribution, D.C. Distribution, Classification of Overhead Transmission Line, Comparison of systems for transmission & distribution, Influence of working voltage in DC system, Systems of transmission, Comparison of cost of conductors for transmission, Choice of working voltage for transmission.
Ch 6 Principles of Overhead Line	Main Components of Overhead Lines, Conductor Materials, Commonly Used Conductor Materials, Line Supports.
Ch 7 Concept of Line Diagram	Constants of a Transmission Line, Resistance of a Transmission Line, Skin Effect, Flux Linkages, Inductance of a Single Phase Overhead Line, Inductance of a 3-Phase Overhead Line, Electric Potential.
Ch 8 Line Construction	String Efficiency, Mathematical Expression, Methods of Improving String Efficiency, Sag in Overhead Lines, Conductor Sag and Tension, Effect of Wind and Ice Loading.
Ch 9 Lightning Arresters	Action, Road Gap Arrester, Expulsion Type Arrester, Valve Type Arrester.
Ch 10 Service Connection & Tests	Connection Schemes of Distribution System, Requirements of a Distribution System, Design Considerations in Distribution System.
Ch 11 Underground Cables	Insulating Materials for Cables, Varnished Cambric, Classification of Cables, Laying of Underground Cables, Insulation Resistance of a Single-Core Cable, Capacitance of Single-Core Cable, Dielectric Stress in a Single Core Cable, Most Economical Conductor Size in a Cable, Cable faults, Location of faults, Measurement of insulation resistance.

Ch 12 Maintenance & Repair of Transmission & Distribution Lines	Foundations, Cabling, Bushing and Cable Boxes, Precautions Against Risk of Fire.
Ch 13 EHV Transmission	Necessity, Problems associated with EHV systems, Limitations & design aspects.
Ch 14 HVDC Transmission Lines	Principles of HVDC Control, HVDC Applications, Advantages of HVDC Systems.

Repairing of Electrical Machine

Ch 1 Repair of electrical machines.	Introduction-Repair Routines, Repair of AC machines, Repairing stator and rotor cores and Windings, Repairing slip rings and short circuiting gears, AC machine Dismantling and Assembling procedure, Repair of DC machines, Repair of shafts, Repair of armatures, Repair of commutators, Mounting and fastening the poles, Repair of yoke and brush holders, Dismantling and assembling DC machines.
Ch 2 To Apply winding to rotors & armature	Terms used in connection with armature winding, Winding a small and big armature, Types of armature winding, Gramme ring winding, Lap winding, Simplex lap winding, Multiplex winding, Brush position for multiplex winding, Wave winding,
Ch 3 Drying & Impregnation of winding	Removal of old insulation, Insulation and impregnation of winding wire , Impregnation cells, Drying ovens, Process of Drying and impregnation of windings.
Ch 4 Tools	Screw Drivers, Pliers, Pocket knife, Hammers, Wooden saw, Chisel, Hand drill, Hacksaw.
Ch 5 Transformer repairing	Types of repair work, Repairing the windings, Repairing the core, Repairing the Tap changers and Leads, Repairing the terminal Bushings, Repairing the tank cover, Repairing the tank, oil conservator and other fittings, Testing the transformer for leak tightness, Drying out of Transformers, Purification and drying of Transformer oil.
Ch 6 Maintenance of a power Transformers	Safety precautions, Daily maintenance, Monthly aintenance, Annual inspections, Un-scheduled maintenance, Maintenance of un-attended transformers, Troubles with power transformers.
Ch 7 Commissioning procedure of a power Transformers	Preparations prior to commissioning, Commissioning tests, Additional checks for parallel operation.
Ch-8 Maintenance Schedule of Induction Motor	Maintenance checks, Daily maintenance, Weekly maintenance, Monthly maintenance, Half yearly maintenance, Annual maintenance, Records, General procedure for over all of motors, Bearing replacement, Break down of motors, Diagnosis of common faults.

Electrical Engineering Drawing

Ch 1 Construction of assembly drawing of the electrical & mechanical item	Symbols Drawing, Lettering and lines, Dimensioning, Projection, Sectional Views, Shafts keys, Coupling, Bearing, Wall brackets, Joints.
Ch 2 Drawing of joints of electrical accessories	Cable joints, Bus-Bar post, Kit –Kat fuse assembly, Knife Switches, Carbon brush holder, Iron clad switch, Cable lugs or Thimbles.
Ch 3 Drawing of common electrical instruments	Moving iron type instrument, Moving coil type instrument, Dynamometer type instrument, Induction type instrument, Controlling and damping devices, Frequency meters, Power factor meters, Synchroscope, Maximum demand indicator, Connection diagram of electrical instrument, Current transformer and potential transformer.
Ch 4 Drawing of electrical machines	D.c machines, D.c motor structure, A.c machines, A.c motor start, Alternator, Single-phase induction motor, Transformer, Examples.
Ch 5 Drawing on panels	D.C Generator panels, Panel for parallel Operation of generator, Alternator panels, Synchronizing, Control panel in a sub-station.
Ch 6 Wiring diagrams	D.C machine winding, A.C.machine winding.
Ch 7 Transmission & distribution line diagrams	Poles, Steel towers, Arrangements of conductors, HT & LT insulators, Guy insulators, 11 Kv pin type insulator, Disc insulator, String insulator, Stays or guys.
Ch 8 Plant & substation layout diagrams	Distribution substation, 33kv and 11kv substation, Hydroelectric power plants, Thermal power plants, Nuclear power plants.