# B.TECH SEMESTER-III
## ELECTRICAL ENGINEERING

### THEORY COURSES:

<table>
<thead>
<tr>
<th>SI. No.</th>
<th>Course No.</th>
<th>Subject</th>
<th>Credits</th>
<th>Teaching Schedule Hrs.</th>
<th>Total</th>
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<tr>
<td>1.</td>
<td>MA-201</td>
<td>Mathematics-II</td>
<td>4</td>
<td>310</td>
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<tr>
<td>2.</td>
<td>EI-201</td>
<td>Analog Electronics</td>
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<tr>
<td>3.</td>
<td>EE-201</td>
<td>Network Analysis &amp; Synthesis (FOR EE, EC &amp; EI BRANCHES)</td>
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<td>4.</td>
<td>EE-203</td>
<td>Electrical Machines-1</td>
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<td>5.</td>
<td>EE-205</td>
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<td>EE-207</td>
<td>Electrical Engineering Materials</td>
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### LABORATORY COURSES:

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<th>Teaching Schedule Hrs.</th>
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<tbody>
<tr>
<td>1.</td>
<td>EE-203(P)</td>
<td>Electrical Machines-I</td>
<td>2</td>
<td>003</td>
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<td>2.</td>
<td>EE-205(P)</td>
<td>Electrical Measurement</td>
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**TOTAL (THEORY + LABORATORY)**: **26** **30**
## B.TECH SEMESTER-IV
### ELECTRICAL ENGINEERING

### THEORY COURSES:

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<tr>
<td>1.</td>
<td>EI-202</td>
<td>Linear IC Application</td>
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<td>2.</td>
<td>EC-203</td>
<td>Electromagnetic Theory</td>
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<td>EC-204</td>
<td>Digital Electronics</td>
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<td>4.</td>
<td>CS-204</td>
<td>Computer Organisation</td>
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<td>5.</td>
<td>EE-204</td>
<td>Electrical Machines-II</td>
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<td>6.</td>
<td>EE-202*</td>
<td>AC &amp; DC Machines (ME,EC &amp; EI)</td>
<td>4</td>
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**Total**  24  24

### LABORATORY COURSES:

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<tr>
<td>1.</td>
<td>EE-204(P)</td>
<td>Electrical Machines-II</td>
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<td>2.</td>
<td>EC-202(P)</td>
<td>Digital Electronics</td>
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<td>3.</td>
<td>EC-204(P)</td>
<td>Analog Electronics</td>
<td>2</td>
<td>003</td>
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<td>4.</td>
<td>EE-202(P)*</td>
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**Total**  8  12

**TOTAL (THEORY + LABORATORY)**  32  36

*NOT APPLICABLE TO EE BRANCH*
## B.TECH SEMESTER-V
### ELECTRICAL ENGINEERING

**THEORY COURSES:**

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<tr>
<td>1.</td>
<td>EE-301</td>
<td>Control System(EC,EI &amp; EE)</td>
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<td>2.</td>
<td>EE-303</td>
<td>Power Electronics(EC,EI &amp; EE)</td>
<td>4</td>
<td>310</td>
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<td>3.</td>
<td>EE-305</td>
<td>Power System-I</td>
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<td>EE-307</td>
<td>Instrumentation</td>
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<td>EI-301</td>
<td>Microprocessor</td>
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<td>6.</td>
<td>EC-202</td>
<td>Signal &amp; System</td>
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**LABORATORY COURSES:**

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**TOTAL (THEORY + LABORATORY)** 32 36
# B.TECH SEMESTER-VI
## ELECTRICAL ENGINEERING

### THEORY COURSES:

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<tr>
<td>1.</td>
<td>EE-302</td>
<td>Power System -II</td>
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<td>EE-304</td>
<td>Power Plant Engineering</td>
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<td>EE-306</td>
<td>Computer Simulation Of Power system</td>
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<td>4.</td>
<td>EE-308</td>
<td>Digital &amp; Non Linear Control System</td>
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<td>5.</td>
<td>EE-310</td>
<td>Special Purpose Machines</td>
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<td>EC-312</td>
<td>Elements of Communication Engg.</td>
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### LABORATORY COURSES:

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<tbody>
<tr>
<td>1.</td>
<td>EE-303(P)</td>
<td>Power Electronics(EC, EI &amp; EE)</td>
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<td>2.</td>
<td>EC-309(P)</td>
<td>Instrumentation</td>
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<td>EI-301(P)</td>
<td>Microprocessor</td>
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**TOTAL (THEORY + LABORATORY)**

|                  | **30** | **33** |
## B.TECH SEMESTER-VII
### ELECTRICAL ENGINEERING

#### THEORY COURSES:

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<tr>
<td>1.</td>
<td>EE-401</td>
<td>Protection &amp; Switchgear</td>
<td>4</td>
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<td>2.</td>
<td>EE-403</td>
<td>High Voltage Engineering</td>
<td>4</td>
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<td>3.</td>
<td>EE-405</td>
<td>Industrial Training</td>
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<td>4.</td>
<td>HU-402</td>
<td>Engineering Economics</td>
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<td>310</td>
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<td>5.</td>
<td>EE-407</td>
<td>Seminar</td>
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#### LABORATORY COURSES:

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<tbody>
<tr>
<td>1.</td>
<td>EE-401(P)</td>
<td>Protection &amp; Switchgear</td>
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<td>EE-403(P)</td>
<td>Project-I</td>
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**TOTAL (THEORY + LABORATORY)**: 33 \( \text{Theory} \) + 29 \( \text{Laboratory} \)

*Pool Elective
1. Non Conventional Energy Sources (EE-411)
2. Neural Networks & Fuzzy Logic (EE-413)
3. Utilization of Electrical Power & Traction (EE-415)

**Open Elective
As per the detailed syllabi
## THEORY COURSES:

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<tr>
<td>1</td>
<td>EE-402</td>
<td>Electric Drives &amp; Control</td>
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<td>EE-404</td>
<td>Electrical Machine Design</td>
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<td>ME-404</td>
<td>Industrial Management</td>
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## LABORATORY COURSES:

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<td>Power System</td>
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<td>EE-406(P)</td>
<td>Project-II</td>
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**TOTAL (THEORY + LABORATORY) 29 28**

**ELECTIVE-III**

1. EE-406 E.H.V AC & DC Transmission
2. EE-408 Power Quality.
3. EE-410 Power System Operation & Control
# B-TECH. SEMESTER-III
## NETWORK ANALYSIS AND SYNTHESIS
### EE-201

**FOR EE, EC & EI BRANCHES**

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</table>

**Unit – I:**

**Graph Theory**: Graph of a Network, definitions, tree, co tree, link, basic loop and basic cut set, Incidence matrix, cut set matrix, Tie set matrix, Duality, Loop and Nodal methods of analysis.

**Unit – II:**

**Network Theorems (Applications to ac networks)**: Super-position theorem, Thevenin’s theorem, Norton’s theorem, maximum power transfer theorem, Reciprocity theorem. Millman’s theorem, compensation theorem, Tellegen’s theorem.

**Unit – III:**

**Laplace transforms**: Introduction to Laplace Transform

**Fourier Series**: Introduction to Fourier Analysis.

**Unit – V:**

**Network Functions**: Concept of Complex frequency, Transform Impedances, Network functions of one port and two port networks, concept of poles and zeros, properties of driving point and transfer functions, time response and stability from pole zero plot.

**Unit – VI:**

**Two Port Networks**: Characterization of LTI two port networks ZY, ABCD and h parameters, reciprocity and symmetry. Inter-relationships between the parameters, inter-connections of two port networks, Ladder and Lattice networks. T & II Representation.

**Unit – VII:**

(a) **Network Synthesis**: Positive real function; definition and properties; properties of LC, RC and RL driving point functions, synthesis of LC, RC and RL driving point immittance functions using Foster and Cauer first and second forms.

(b) **Filters**: Image parameters and characteristics impedance, passive and active filter fundamentals, low pass, highpass, (constant K type) filters, and introduction to active filters.

**Text Books:**
1. Networks and Systems, D. Roy Chowdhury, New Age International Publishers

**Reference Books:**
1. Network Analysis, M.E. Valkenburg, Pearson Education.
UNIT – I
Crystal Structure of Materials:
A. Bonds in solids, crystal structure, co-ordination number, atomic packing factor, Miller Indices, Bragg’s law and x-ray diffraction, structural Imperfections, crystal growth

UNIT-II
Dielectric Material:

UNIT – III
Conductivity of Metals:
Electron theory of metals, factors affecting electrical resistance of materials, thermal conductivity of metals, heat developed in current carrying conductors, thermoelectric effect, superconductivity and super conducting materials, Properties and applications of electrical conducting and insulating materials, mechanical properties of metals.

UNIT – IV
Mechanism of Conduction in semiconductor materials:
Types of semiconductors, current carriers in semiconductors, Half effect, Drift and Diffusion currents, continuity equation, P-N junction diode, junction transistor, FET & IGFET, properties of semiconducting materials.

UNIT – V
Magnetic Properties of Material:
Origin of permanent magnetic dipoles in matters, Classification Diamagnetism, Paramagnetism, Ferromagnetism, Antiferromagnetism and Ferrimagnetism, magnetostriction, properties of magnetic materials, soft and hard magnetic materials, permanent magnetic materials.

Text Books :
1 A.J. Dekker,”Electrical Engineering Materials” Prentice Hall of India

Reference Books :
UNIT – I
Electromechanical Energy Conversion Principles:
Principle of energy conversion.

UNIT-II
Single Phase Transformer:
Construction & principle of ideal two winding transformer, no-load current waveform, plotting of no-load current waveform from B-H curve, phasor diagrams at no-load and at load conditions, rating, equivalent circuit, tests, voltage regulation, losses and efficiency, auto transformer, parallel operation of single phase transformer.

UNIT-III
Three Phase Transformer
Types of connections, 3 to 2 phase & 3 to 6 phase conversions.

UNIT-IV
D.C. Machines:- Construction of DC Machines, Armature winding, Emf and torque equation, Armature Reaction, Commutation, Interpoles and Compensating Windings, Self excitation of shunt generator, Performance; Types & Characteristics of D.C. generators.

UNIT-V
D.C. Machines (Contd.):-
Performance & Characteristics of D.C. motors, Starting of D.C. motors; 3 point and 4 point starters, Speed control of D.C. motors: Field Control, armature control and Voltage Control (Ward Leonard method); Efficiency and Testing of D.C.machines (Hopkinson’s, Swinburn’s Test & Direct load test)

Text Books:
2. Husain Ashfaq ,” Electrical Machines”, Dhanpat Rai & Sons

Reference Books:
UNIT I:–
(1) Philosophy Of Measurement: Methods of Measurement, Measurement System, Classification of instrument system, Characteristics of instruments & measurement system, Errors in measurement & its analysis, Standards.
(2) Analog Measurement of Electrical Quantities: Electrodynamic, Thermocouple, Electrostatic & Rectifier type Ammeters & Voltmeters, Electrodynamic Wattmeter, Three Phase Wattmeter, Power in three phase system, errors & remedies in wattmeter and energy meter.

UNIT II:
Instrument Transformer and their applications in the extension of instrument range, Introduction to measurement of speed, frequency and power factor.

UNIT III:
Measurement of Parameters: Different methods of measuring low, medium and high resistances, measurement of inductance & capacitance with the help of AC Bridges, Q Meter.

UNIT IV:
(1) AC Potentiometer: Polar type & Co-ordinate type AC potentiometers, application of AC Potentiometers in electrical measurement
(2) Magnetic Measurement: Ballistic Galvanometer, flux meter, determination of hysteresis loop, measurement of iron losses.

Text Book:

Reference Books:
B-TECH. SEMESTER-IV
ELECTRICAL MACHINE-II
EE-204

<table>
<thead>
<tr>
<th>L</th>
<th>T</th>
<th>P</th>
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<tbody>
<tr>
<td>3</td>
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</table>

UNIT-I
Synchronous Machine I

UNIT-II
Synchronous Machine II:
Two Reaction Theory, Power flow equations of cylindrical and salient pole machines, operating characteristics
Synchronous Motor:
Starting methods, Effect of varying field current at different loads, V- Curves, Hunting & damping, synchronous condenser

UNIT-III:
Three phase Induction Machine – I
Constructional features, Rotating magnetic field, Principle of operation, Phasor diagram, equivalent circuit, torque and power equations, Torque- slip characteristics, no load & blocked rotor tests, efficiency, methods of starting, methods of speed control of induction motor- pole changing, stator voltage control, stator frequency control, cascading, V/F method of speed control, rotor voltage injection method, cogging, crawling.

Text Books:
2. Ashfaq Hussain“Electric Machines” Dhanpat Rai & Company

Reference Books:
4. P.S.Bimbhra, “Electrical Machinery”, Khanna Publisher
6. M.G.Say, “Alternating Current Machines”, Pitman & Sons
B-TECH. SEMESTER-IV
ELEMENTS OF ELECTRICAL ENGINEERING
EE-202

<table>
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UNIT-I
TRANSFORMER:
Principle & construction of single phase transformer, EMF equation, phasor diagram, equivalent circuit diagram, SC test, OC test, efficiency.

UNIT-II
DC MACHINES:
Principle & construction of DC generator, types of windings, types of DC generator, OCC, load characteristics, principle & construction of DC motor, back EMF, torque equation, load characteristics.

UNIT-III
INDUCTION MOTORS:
Principle and construction of 3-phase induction motor, concept of slip, phasor diagram. Equivalents circuit diagram, T-S characteristics.

UNIT-IV
SYNCHRONOUS MACHINES:

Text Books:
Electrical Technology by B.L. Theraja
P.S. Bimbhra, “Electrical Machinery”, Khanna Publisher
Unit-I
The Control System:
Open loop & closed control; servomechanism, Physical systems. Principle of feedback Transfer functions, Block diagram algebra, Signal flow graph, Mason’s gain formula Reduction of parameter variation and effects of disturbance by using negative feedback.

Unit-II
Time Response analysis:
Standard test signals, time response of first and second order systems, time response specifications, steady state errors and error constants, Design specifications of second order systems: basic concept of P, PD, PI, PID controllers.

Unit-III
Stability and Algebraic Criteria:
Concept of stability and necessary conditions, Routh-Hurwitz criteria and limitations.

Root Locus Technique:
The root locus concepts, construction of root loci

Unit-IV
Frequency response Analysis: Frequency response, correlation between time and frequency responses, polar plots, Bode plots

Stability in Frequency Domain:
Frequency Domain specifications, Nyquist stability criterion, assessment of relative stability: gain margin and phase margin, constant M&N circles.

Text Books:

Reference Books:
Oxford University Press.
Unit-I
Power System Components:
Single line Diagram of Power system, Brief description of power system Elements: Synchronous machine, transformer, transmission line, bus bar, circuit breaker and isolator
Supply System
Different kinds of supply system and their comparison, choice of transmission voltage
Transmission Lines:
Configurations, types of conductors, resistance of line, skin effect, Kelvin’s law. Proximity effect

Unit-II
Over Head Transmission Lines
Calculation of inductance and capacitance of single phase, three phase, single circuit and double circuit transmission lines, Representation and performance of short, medium and long transmission lines, Ferranti effect. Surge impedance loading

Unit-III
Corona and Interference:
Phenomenon of corona, corona formation, calculation of potential gradient, corona loss, factors affecting corona, methods of reducing corona and interference. Electrostatic and electromagnetic interference with communication lines
Overhead line Insulators:
Type of insulators and their applications, potential distribution over a string of insulators, methods of equalizing the potential, string efficiency

Unit-IV
Mechanical Design of transmission line:
Catenary curve, calculation of sag & tension, effects of wind and ice loading, sag template, vibration dampers
Insulated cables:
Type of cables and their construction, dielectric stress, grading of cables, insulation resistance, capacitance of single phase and three phase cables, dielectric loss, heating of cables

Text Books
3. Asfaq Hussain, “Power System”, CBS Publishers and Distributors,

Reference Books
Unit-I

Power semiconductor Devices:
Power semiconductor devices their symbols and static characteristics. Characteristics and specifications of switches, types of power electronic circuits. Operation, steady state & switching characteristics & switching limits of Power Transistor. Operation and steady state characteristics of Power MOSFET and IGBT.

Thyristor – Operation, V-I characteristics, two transistor model, methods of turn-on. Operation of GTO, MCT and TRIAC.

Unit-II

Power Semiconductor Devices(Contd)

DC Choppers:

Unit-III

Phase Controlled Converters
Single phase half wave controlled rectifier with resistive and inductive loads, effect of freewheeling diode. Single phase fully controlled and half controlled bridge converters.
Performance Parameters. Three phase half wave converters. Three phase fully controlled and half controlled bridge converters, Effect of source impedance, Single phase and three phase dual converters.

Unit-IV

AC Voltage Controllers
Principle of On-Off and phase controls. Single phase ac voltage controller with resistive and inductive loads. Three phase ac voltage controllers (various configurations and comparison only).
Single phase transformer taps changer.

Unit-V

Inverters
Single phase series resonant inverter. Single phase bridge inverters. Three phase bridge inverters

Unit-VI

Cycloconverters:
1- φ & 3- φ Cyclo-converters, mid-point & bridge type cyclo-converters, advantage of cyclo-converters.

Text Books:

Reference Books:
4. M.S. Jamil Asghar, “Power Electronics” Prentice Hall of India Ltd., 2004
Unit-I:
**Transducer – I:**
Definition, advantages of electrical transducers, classification, characteristics, factors affecting the choice of transducers, Potentiometers, Strain guages, Resistance thermometer, Thermistors, Thermocouples, LVDT, RVDT

Unit-II
**Transducer – II:**
Capacitive, Piezoelectric Hall effect and opto electronic transducers. Measurement of Motion, Force pressure, temperature, flow and liquid level.

Unit-III:
**Telemetry:**
General telemetry system, land line & radio frequency telemetering system, transmission channels and media, receiver & transmitter. Data

**Acquisition System:**
Analog data acquisition system, Digital data acquisition system, Modern digital data acquisition system.

Unit-IV:
**Display Devices and Recorders:**
Display devices, storage oscilloscope, spectrum analyzer, strip chart & x-y recorders, magnetic tape & digital tape recorders.

**Recent Developments:**
Computer aided measurements, fibre optic transducers, microsensors, smart sensors, smart transmitters.

Unit-V:
**Process Control:**
Principle, elements of process control system, process characteristics, proportional (P), integral (I), Derivative (D), PI, PD and PID control modes. Electronic, Pneumatic & digital controllers.

UNIT VI:
**Cathode Ray Oscilloscope:** Basic CRO circuit (Block Diagram), Cathode ray tube (CRT) & its components, application of CRO in measurement, Lissajous Pattern.

**Text Books:**

**Reference Books:**
6. Rajendra Prasad,”Electronic Measurement and Instrumentation Khanna Publisher
Unit-I
**Representation of Power System Components:**
Synchronous machines, Transformers, Transmission lines, One line diagram, Impedance and reactance diagram, per unit System

**Symmetrical components:**
Symmetrical Components of unbalanced phasors, power in terms of symmetrical components, sequence impedances and sequence networks.

Unit-II
**Insulation Coordination:**
Introduction, Definitions, Determination of Insulation, Impulse Level and Insulation Level of Sub Station Equipment – Lighting Arrester Selection and Location

Unit-III
**Traveling Waves:**
Wave equation for uniform Transmission lines, velocity of propagation, surge impedance, reflection and transmission of traveling waves under different line loadings. Bewlay’s lattice diagram, protection of equipments and line against traveling waves

Unit-IV
**Neutral grounding:**
Necessity of neutral grounding, various methods of neutral grounding, earthing transformer, grounding practices

Unit-V
**Electrical Design of Transmission Line:**
Design consideration of EHV transmission lines, choice of voltage, number of circuits, conductor configuration, insulation design, selection of ground wires.

Text Books:

Reference Books:
5. L. P. Singh; “Advanced Power System Analysis & Dynamics”, New Age International
Unit-I
Symmetrical fault analysis:
Transient in R-L series circuit, calculation of 3-phase short circuit current and reactance of synchronous machine, internal voltage of loaded machines under transient conditions

Unit-II
Unsymmetrical faults:
Analysis of single line to ground fault, line-to-line fault and Double Line to ground fault on an unloaded generators and power system network with and without fault impedance. Formation of Zbus using singular transformation and algorithm, computer method for short circuit calculations

Unit-III
Load Flows:
Introduction, bus classifications, nodal admittance matrix (bus Y), development of load flow equations, load flow solution using Gauss Siedel and Newton-Raphson method, approximation to N-R method, line flow equations and fast decoupled method

Unit-IV
Power System Stability:
Stability and Stability limit, Steady state stability study, derivation of Swing equation, transient stability studies by equal area criterion and step-by-step method. Factors affecting steady state and transient stability and methods of improvement

Text Books:
UNIT-I
INTRODUCTION:
Planning of electricity supply, prediction of load and energy demand forecast techniques.

UNIT-II
THERMAL STATION:
Detailed description of thermal plant-coal handling plant, boiler, economizer, preheater, electrostatic precipitator, ash disposal.

UNIT-III
HYDRO-STATION:
Types of turbines, types of dams, description of hydro plant.

UNIT-IV
NUCLEAR STATION:
Nuclear fuels, nuclear reaction, types of reactors, description of nuclear plant.

Text Books:
2. Power System analysis by W.D Stevenson Granger MGH.
3. Power System Engineering by Nagrath and Kothari TMH.
UNIT-I
Signal Processing in Digital Control:
Basic digital control system, advantages of digital control and implementation problems, basic discrete time signals, z-transform and inverse z-transform, modeling of sample-hold circuit, pulse transfer function, solution of difference equation by z-Transform method.

UNIT-II
Design of Digital Control Algorithms:
Steady state accuracy, transient response and frequency response specifications, digital compensator design using frequency response plots and root locus plots.

UNIT-III
State Space Analysis and Design:
State space representation of digital control system, conversion of state variable models to transfer functions and vice versa, solution of state difference equations, controllability and observability, design of digital control system with state feedback.

UNIT-IV
Stability of Discrete System:
Stability on the z-plane and Jury stability criterion, bilinear transformation, Routh stability criterion on rth plane.
Lyapunou’s Stability in the sense of Lyapunou, stability theorems for continuous and discrete systems, stability analysis using Lyapunor’s method.

Text Books:

Reference Books:
UNIT-I
INDUCTION MOTOR:
Deep bar & double cage type three phase induction motor, single phase induction motors-double field revolving theory & cross field theory, type s of single phase induction motor-capacitor start/run motor, shaded pole, hysteresis motor.

UNIT-II
LINEAR INDUCTION MOTOR:
Principle, magnetic levitation, types of LIM.

UNIT-III
COMMUTATOR MACHINES:

UNIT-IV
CROSS FIELD THEORY:
Cross field generator-Amplidyne and metadyne.

UNIT-V
SPECIAL MACHINES:
Stepper motor-variable reluctance type and hybrid type, ac & dc servomotors, switched reluctance motor, permanent magnet motor.

Text Books:
Unit I:
**Introduction to Protection System:**
Introduction to protection system and its elements, functions of protective relaying, protective zones, primary and backup protection, desirable qualities of protective relaying, basic terminology.

**Relays:**
Electromagnetic, attracted and induction type relays, thermal relay, gas actuated relay, design considerations of electromagnetic relay.

Unit-II:
**Relay Application and Characteristics:**
Amplitude and phase comparators, over current relays, directional relays, distance relays, differential relay

**Static Relays:**
Comparison with electromagnetic relay, classification and their description, over current relays, directional relay, distance relays, differential relay.

Unit-III
**Protection of Transmission Line:**
Over current protection, distance protection, pilot wire protection, carrier current protection, protection of bus, auto re-closing,

Unit-IV:
**Circuit Breaking:**
Properties of arc, arc extinction theories, re-striking voltage transient, current chopping, resistance switching, capacitive current interruption, short line interruption, circuit breaker ratings.

**Testing Of Circuit Breaker:**
Classification, testing station and equipments, testing procedure, direct and indirect testing

Unit-V
**Apparatus Protection:**
Protection of Transformer, generator and motor.

**Circuit Breaker:**
Operating modes, selection of circuit breakers, constructional features and operation of Bulk Oil, Minimum Oil, Air Blast, SF6, Vacuum and d. c. circuit breakers.

Text Books:
2. B. Ravindranath and M. Chander, Power system Protection and Switchgear, iley Eastern Ltd.

Reference Books:
5. T.S.M Rao,“Power System Protection: Static Relays with Microprocessor Applications” Tata Macgraw Hill”.
UNIT-I
**Break Down In Gases:**
Ionization processes, Townsend’s criterion, breakdown in electronegative gases, time lags for breakdown, streamer theory, Paschen’s law, break down in non-uniform field, breakdown in vacuum.

**Break Down In Liquid Dielectrics:**
Classification of liquid dielectric, characteristic of liquid dielectric, breakdown in pure liquid and commercial liquid.

**Break Down In Solid Dielectrics:**
Intrinsic breakdown, electromechanical breakdown, breakdown of solid, dielectric in practice, breakdown in composite dielectrics.

UNIT-II
**Generation of High Voltages and Currents:**
Generation of high direct current voltages, generation of high alternating voltages, generation of impulse voltages, generation of impulse currents, tripping and control of impulse generators.

UNIT-III
**Measurement of High Voltages and Currents:**
Measurement of high direct current voltages, measurement of high alternating and impulse voltages, measurement of high direct, alternating and impulse currents, Cathode Ray Oscillographs for impulse voltage and current measurements.

UNIT-IV
**Non-Destructive Testing:**
Measurement of direct current resistively, measurement of dielectric constant and loss factor, partial discharge measurements

**High Voltage Testing:**
Testing of insulators and bushings, testing of isolators and circuit breakers, testing of cables, testing of transformers, testing of surge arresters, radio interference measurements.

Text Book:

Reference Books:
7. Subir Ray,’ An Introduction to High Voltage Engineering’ Prentice Hall of India
UNIT-I
INTRODUCTION:
Power Crisis, future energy demand, role of Private sectors in energy management,

UNIT-II
MHD generation:
Working principle, open and closed cycles, MHD systems, advantages, parameters governing power output.

UNIT-III
Solar power plant:
Conversion of solar heat to electricity, Solar energy collectors, Photovoltaic cell, power generation, future prospects of solar energy use.

UNIT-IV
Wind Energy:
Windmills, power output with combined operation of wind turbine generation and isolated generating system, technical choices & economic size.

UNIT-V
Geothermal Energy:
Earth energy, heat extraction, vapor turbine cycle, difficulties & disadvantages

UNIT-VI
Tidal energy:
Tidal phenomenon, tidal barrage, tidal power Schemes.

UNIT-VII
Ocean Thermal Energy:
Introduction, energy conversion, problems.

UNIT-VIII
Chemical Energy Sources:
Fuel cells, classifications, hydrogen production, hydrogen energy, utilization of hydrogen gas.

UNIT-IX
Thermoionic generator:
Basic principle Thermoionic generator.

Text Books:
1. Non-conventional energy sources by G.D. Rai, Khanna Publisher.
Unit-I
Neural Networks-1(Introduction & Architecture)
Neuron, Nerve structure and synapse, Artificial Neuron and its model, activation functions, Neural network architecture: single layer and multilayer feed forward networks, recurrent networks. Various learning techniques; perception and convergence rule, Auto-associative and hetero-associative memory

Unit-II
Neural Networks-II (Back propagation networks)
Architecture: perceptron model, solution, single layer artificial neural network, multilayer perception model; backpropagation learning methods, effect of learning rule co-efficient; backpropagation algorithm, factors affecting backpropagation training, applications.

Unit-III
Fuzzy Logic-I (Introduction)
Basic concepts of fuzzy logic, Fuzzy sets and Crisp sets, Fuzzy set theory and operations, Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp conversion.

Unit-IV
Fuzzy Logic –II (Fuzzy Membership, Rules)
Membership functions, interference in fuzzy logic, fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzyfication & Defuzzification, Fuzzy Controller, Industrial applications.

Unit-V
Fuzzy Neural Networks:
L-R Type fuzzy numbers, fuzzy neutron, fuzzy back propagation(BP), architecture, learning in fuzzy BP, inference by fuzzy BP, applications.

Text Books:
1. Kumar Satish, “Neural Networks” Tata Mc Graw Hill

Reference Books:
3. Siman Haykin,”Neural Networks”Prentice Hall of India
4. Timothy J. Ross, “Fuzzy Logic with Engineering Applications” Wiley India.
Unit-I:
Electric Heating:
Advantages and methods of electric heating, Resistance heating, Electric arc heating, Induction heating, Dielectric heating

Unit-II:
Electric Welding:
Electric Arc Welding, Electric Resistance welding, Electronic welding control

Electrolyte Process:
Principles of electro deposition, Laws of electrolysis, applications of electrolysis

Unit-III
Illumination:
Various definitions, Laws of illumination, requirements of good lighting Design of in door lighting and outdoor lighting systems

Refrigeration and Air Conditioning:
Refrigeration systems, domestic refrigerator, water cooler Types of air conditioning, Window air conditioner

Unit-IV:
Electric Traction - I
Types of electric traction, systems of track electrification Traction mechanics- types of services, speed time curve and its simplification, average and schedule speeds Tractive effort, specific energy consumption, mechanics of train movement, coefficient of adhesion and its influence

Unit-V:
Electric Traction – II
Salient features of traction drives Series – parallel control of dc traction drives (bridge transition) and energy saving Power Electronic control of dc and ac traction drives Diesel electric traction.

Text Books:

Reference Books:
Unit-I:  
**Fundamentals of Electric Drive:**  
- Electric Drives and its parts, advantages of electric drives  
- Classification of electric drives  
- Speed-torque conventions and multi-quadrant operations  
- Constant torque and constant power operation  
- Types of load  
- Load torque: components, nature and classification  

Unit-II:  
**Dynamics of Electric Drive:**  
- Dynamics of motor-load combination; Steady state stability of Electric Drive; Transient stability of electric Drive  
- **Selection of Motor Power rating:**  
  - Thermal model of motor for heating and cooling, classes of motor duty, determination of motor power rating for continuous duty, short time duty and intermittent duty. Load equalization  

Unit-III:  
**Electric Braking:**  
- Purpose and types of electric braking, braking of dc, three phase induction and synchronous motors  
- **Dynamics During Starting and Braking:**  
  - Calculation of acceleration time and energy loss during starting of dc shunt and three phase induction motors, methods of reducing energy loss during starting. Energy relations during braking, dynamics during braking  

Unit-IV:  
**Power Electronic Control of DC Drives:**  
- Single phase and three phase controlled converter fed separately excited dc motor drives (continuous conduction only), dual converter fed separately excited dc motor drive, rectifier control of dc series motor. Supply harmonics, power factor and ripples in motor current  
- Chopper control of separately excited dc motor and dc series motor.  

Unit-V:  
**Power Electronic Control of AC Drives: Three Phase induction Motor Drive:**  
- Static Voltage control scheme, static frequency control scheme (VSI, CSI, and cyclo-converter based) static rotor resistance and slip power recovery control schemes.  
- **Three Phase Synchronous motor:**  
  - Self controlled scheme  
- **Special Drives:**  
  - Switched Reluctance motor, Brushless dc motor. Selection of motor for particular applications  

**Text Books:**  

**Reference Books:**  
UNIT-I
Basic Considerations:
Basic concept of design, limitation in design, standardization, modern trends in design and manufacturing techniques, Classification of insulating materials. Calculation of total mmf and magnetizing current. Transformer Design: Output equation design of core, yoke and windings, overall dimensions, Computation of no load current to voltage regulation, efficiency and cooling system designs

UNIT-II
Design of rotating machines – I:
Output equations of rotating machines, specific electric and magnetic loadings, factors affecting size of rotating machines, separation of main dimensions, selection of frame size. Core and armature design of dc and 3-phase ac machines

UNIT-III
Design of rotating machines – II:
Rotor design of three phase induction motors. Design of field system of DC machine and synchronous machines. Estimation of performance from design data.

UNIT-IV
Computer Aided Design
Philosophy of computer aided design, advantages and limitations.
Computer aided design approaches analysis, synthesis and hybrid methods.
Concept of optimization and its general procedure.
Flow charts and ‘c’ based computer programs for the design of transformer, dc machine, three phase induction and synchronous machines.

Text Books:

Reference Books:
UNIT-I
Introduction:
Need of EHV transmission, standard transmission voltage, comparison of EHV ac & dc transmission systems and their applications & limitations, surface voltage gradients in conductor, distribution of voltage gradients on sub-conductors, mechanical considerations of transmission lines, modern trends in EHV AC and DC transmission

UNIT-II
EHV AC Transmission:
Corona loss formulas, corona current, audible noise – generation and characteristics corona pulses their generation and properties, radio interference (RI) effects, over voltage due to switching, ferroresonance, reduction of switching surges on EHV system, principle of half wave transmission.

UNIT-III
Extra High Voltage Testing:
Characteristics and generation of impulse voltage, generation of high Ac and Dc voltages, measurement of high voltage by sphergaps and potential dividers.

Consideration for Design of EHV Lines:
Design factors under steady state limits, EHV line insulation design based upon transient over voltages. Effects of pollution on performance of EHV lines.

UNIT-IV
EHV DC Transmission – I:
Types of dc links, converter station, choice of converter configuration and pulse number, effect of source inductance on operation of converters. Principle of dc link control, converter controls characteristics, firing angle control, current and excitation angle control, power control, starting and stopping of dc link.

UNIT-V
EHV DC Transmission – II:
Converter faults, protection against over currents and over voltages, smoothing reactors, generation of harmonics, ac and dc filters, Multi Terminal DC systems (MTDC): Types, control, protection and applications.

Text Books:

Reference Books:
Unit-I
**Introduction to Power Quality:**
Terms and definitions of transients,
Long Duration Voltage Variations: under Voltage, Under Voltage and Sustained Interruptions;
Short Duration Voltage Variations: interruption, Sag, Swell; Voltage Imbalance; Notching DC offset, waveform distortion; voltage fluctuation; power frequency variations.

Unit-II
**Voltage Sag:** Sources of voltage sag: motor starting, arc furnace, fault clearing etc; estimating voltage sag performance and principle of its protection; solutions at end user level- Isolation Transformer, Voltage Regulator, Static UPS, Rotary UPS, Active Series Compensator.

Unit-III
**Electrical Transients:** Sources of Transient Over voltages- Atmospheric and switching transients- motor starting transients, pf correction capacitor switching transients, ups switching transients, neutral voltage swing etc; devices for over voltage protection.

Unit-IV
**Harmonics:** Causes of harmonics; current and voltage harmonics: measurement of harmonics; effects of harmonics on – Transformers, AC Motors, Capacitor Banks, Cables, and Protection Devices, Energy Metering, Communication Lines etc. harmonic mitigation techniques.

Unit-V
**Measurement and Solving of Power Quality Problems:** Power quality measurement devices-Harmonic Analyzer , Transient Disturbance Analyzer, wiring and grounding tester, Flicker Meter, Oscilloscope, multimeter etc.

**Introduction to Custom Power Devices**-Network Reconfiguration devices; Load compensation and voltage regulation using DSTATCOM; protecting sensitive loads using DVR; Unified power Quality Conditioner. (UPQC)

Text Books:
UNIT-I
Introduction:
Structure of power systems, Power system control center and real time computer control, SCADA system. Level decomposition in power system. Power system security. Various operational stages of power system. Power system voltage stability

UNIT-II
Economic Operation:

UNIT-III
Load Frequency Control:
Concept of load frequency control, Load frequency control of single area system:
Turbine speed governing system and modeling, block diagram representation of single area system, steadystate analysis, dynamic response, control area concept, P-I control, load frequency control and economic dispatch control. Load frequency control of two area system:
Tie line power modeling, block diagram representation of two area system, static and dynamic response

UNIT-IV
Automatic Voltage Control:
Schematic diagram and block diagram representation, different types of Excitation systems & their controllers.

Voltage and Reactive Power control:
Concept of voltage control, methods of voltage control-control by tap changing transformer. Shunt Compensation, series compensation, phase angle compensation

UNIT-V
State Estimation:
Detection and identification, Linear and non-linear models.

Flexible AC Transmission Systems:
Concept and objectives
FACTs controllers: Structures & Characteristics of following FACTs Controllers. TCR,FC-TCR, TSC, SVC, STATCOM, TSSC, TCSC, SSSC, TC-PAR, UPFC

Text Books: