ELECTRONIC DEVICES AND CIRCUITS

UNIT I - PN JUNCTION DIODE AND SPECIAL PURPOSE ELECTRONIC DEVICES

Electrical properties of materials - Types of materials, Electrical properties of materials. **Energy level diagrams of materials -** Energy bands in solids, Hole and its movements, Energy bands in conductors, semiconductors and insulators. **Classification of Semiconductors** - Types of Semiconductors, Comparison of Intrinsic and Extrinsic semiconductors. **Formation of n-type and p-type semiconductor** - Doped semiconductors, N-type semiconductor, Formation and conduction in N-type semiconductor, P–type semiconductor, Formation and conduction in P-type semiconductor. **Majority and Minority carriers** - Majority and minority carriers, Conduction in semiconductors. **PN junction diode** - Introduction to PN junction, Formation of PN junction, Formation of depletion region, Barrier potential, Band Structure of PN Junction. **Operation of PN junction diode** - Biasing of PN junction diode, Forward biasing of PN junction diode, Effect on the depletion region and barrier potential, Reverse biasing of PN junction diode, Breakdown in reverse biased, Comparison of breakdown mechanism, V-I characteristics of a diode. **Diode equation** - Diode equation. **Temperature effects** - Temperature effects, Reverse saturation current, Cut-In voltage. **Diode switching characteristics** - Diode switching characteristics, Analysis of diode circuits, Diode models, Diode parameters. **Ideal vs Practical diode - Diode resistance** - Diode resistance, Forward resistance, Reverse resistance. **Diode capacitances** - Diode capacitances, Transition capacitance, Diffusion capacitance. **Diode equivalent circuit** - Diode equivalent circuit, Piecewise-Linear equivalent circuit, Simplified equivalent circuit, Ideal equivalent circuit, Summary (Diode equivalent circuits). **Loadline analysis and breakdown mechanisms in semiconductor diodes** - Load line analysis, Breakdown mechanisms in semiconductor diodes. **Specifications and applications of diodes** - Diode - Variants, Diode numbering, Specifications of diodes, Applications of PN junction diodes. **Solved problems for semiconductor** - Problem to calculate reverse and forward resistance, Problem to calculate DC and dynamic forward resistance, Problem to calculate diode current, Problem to calculate forward diode current, Problem to calculate forward voltage drop. **Zener diode** - Introduction to Zener diode, Zener breakdown, Avalanche breakdown, Differences between Zener and Avalanche break downs. **Zener diode characteristics** - V-I Characteristics of Zener diode, Specifications of Zener Diode, Application of Zener Diode. **Tunnel diode** - Introduction to tunnel diode, Tunnel diode construction, Principle of tunnel diode, Equivalent circuit of the tunnel diode, Comparison of tunnel diode and conventional diode. **Varactor diode** - Varactor diode, Working principle of varactor diode, Doping profile in varactor diode, Applications of varactor diodes. **Silicon Controlled Rectifier (SCR)** - Silicon controlled rectifier, Power control using SCR, Operation of SCR, Characteristics of SCR, DC power control using SCR, Applications of SCR. **Photodiode** - Introduction of photodiode, Working and characteristics of photodiode, Advantages and disadvantages of photodiode, Applications of photodiode.

UNIT II - RECTIFIERS AND FILTERS

Power supply - Introduction to necessity of DC power supply, Introduction of power supply, Classification of power supply, Linear mode power supply, Switch Mode Power Supply (SMPS).

Rectifiers - PN junction diode as a rectifier, Need of rectifier, Classification of rectifiers. **Halfwave rectifier** - Halfwave rectifier, Halfwave rectifier parameters, Average DC load current and Average DC load voltage, R.M.S. value of load current and load voltage, DC power output and AC power input, Rectifier efficiency, Ripple factor and Load current, Peak Inverse Voltage (PIV) and Transformer Utilization Factor (TUF), Voltage regulation, Advantages and disadvantages of HWR. **Center tapped full wave rectifier** - Full wave rectifier, Maximum load current, Average DC load current and voltage, RMS value, power input and power output, Rectifier efficiency, Ripple factor, Load current, Peak Inverse Voltage (PIV), Transformer Utilization Factor (TUF), Voltage regulation, Advantages and disadvantages of Full Wave Rectifier (FWR). **Full wave bridge rectifier** - Bridge Rectifier (BR), Expression for various parameters, Advantages and disadvantages of Bridge Rectifier (BR), Comparison of half wave, full wave and bridge rectifier, Harmonic components in a rectifier circuit. **Solved problems for rectifier** - Problem to calculate Ripple Factor, Problem to calculate Ripple Voltage, Problem to calculate Load Voltage, Problem to calculate Capacitance, Problem to calculate Ripple Voltage, Problem to calculate Peak Rectified Voltage, Problem to design a halfwave rectifier, Problem to design a fullwave rectifier. **Inductor filter or choke filter** - Filter, Inductor filter or (Choke filter), Ripple factor. **Capacitor (c) Filter** - Capacitor (C) filter, Ripple factor. **LC Filter** - LC Filter, Ripple factor, Advantages and Disadvantages of LC filters. **CLC (PHI) Filter** - CLC (PHI) Filter, Ripple factor, Advantages and Disadvantages of CLC filters. **Comparison of filters** - Comparison between capacitor input filter and LC filter. **Voltage regulators** - Introduction of voltage regulation, Types of voltage regulators, Zener diode shunt regulator, Stability factor for Zener voltage regulator, Advantages and disadvantages of Zener voltage regulator, Transistor shunt regulator, Emitter follower series voltage regulator.

UNIT III - BIPOLAR JUNCTION TRANSISTOR AND UJT

Bipolar junction transistor - Introduction of transistor, Formation of transistor, Types of transistor, PNP transistor, NPN transistor, Transistor as an amplifier in CB configuration, Transistor configurations, Operation region of a transistor (CB configuration). **Early effect** - Early Effect or Base-width Modulation. **Transistor current components** - Current components in transistor. **Transistor as an amplifier and switch** - Introduction of amplifier, Active devices used for amplification, Transistor as an amplifier, Introduction, CE configuration is most widely used in amplifier circuit, Regions of operation of a transistor, Salient points of C.E. Amplifier, Transistor as a switch. **Transistor configurations** - Common base configuration, Common emitter configuration, Common collector configuration. **Characteristics of transistor** - Input characteristics of a transistor in a CB configuration, Output characteristics of a Transistor in CB configuration, Three regions in the output characteristics of CB-Configuration, Input characteristics of CE configuration, Output characteristics of CE configuration, Three regions in the output characteristics of CE-Configuration, Input and Output characteristics of CC configuration. **Transistor's parameters and specifications** - BJT operating limits, Alpha, Beta and Gamma factors, Current amplification factor, Specification of transistor, Different types of packages in transistor. **Hybrid parameter** - Introduction, Hybrid parameter, Equivalent circuit for h parameter. **Hybrid-Pi Model** - Hybrid-Pi Model, Example problem. **Comparison of three configurations** - Comparison of three configurations. **Unijunction Transistor (UJT)** - Unipolar Junction Transistor (UJT),

Equivalent circuit of UJT, Working of UJT. **Characteristics of UJT** - Characteristics of UJT, UJT Relaxation Oscillator, Features of UJT, Applications of UJT.

UNIT IV - TRANSISTOR BIASING AND STABILIZATION

Transistor load lines - Introduction to transistor load lines, DC load line, AC load line. **Introduction to operating point and load lines -** Introduction to operating point and load lines. **Need for biasing -** Operation region of a transistor. **Various biasing methods for BJT -** Transistor biasing, Various biasing methods for BJT. **Fixed bias using a PNP transistor -** Fixed bias using a PNP transistor, Stability factor S, Stability factor S', Stability factor S', Advantages and disadvantages of fixed bias circuit, Problem to find stability factor S'. **Collector to base bias circuit -** Collector to base bias circuit, Problems to determine IC and VCE, Design Examples, Modified collector to base bias circuit, Problems to determine operating point, Stability Factor S for collector to base bias circuit, Stability Factor S', Stability Factor S', Stability Factor S', Problems to determine RB, Problems to determine operating point of the circuit. **Voltage divider bias / Self bias circuit -** Voltage divider bias / Self bias circuit, Simplified circuit of voltage divider bias, Problem to calculate VCE and IC, Problem to find the q - point, Stability factor for Voltage divider bias, Voltage divider (self) Bias using PNP transistor, Design example. **Emitter stabilized bias circuit -** Emitter stabilized bias circuit, Circuit analysis, Problem to determine IB, IC, VCE, VC, VE and VBC, Stability improvement. **Need for bias stabilisation -** Causes for instability of biasing, Need for bias stabilization. **Stability factor -** Stabilization, Stability factor, Stability factor for different types of biasing circuits, Method of stabilizing the q point to the extent possible. **Bias compensation -** Diode compensation, Thermistor compensation, Sensistor compensation. **Thermal Runaway -** Thermal Runaway, Thermal resistance, Operating point considerations. **Thermal stability -** The condition for thermal stability, Thermal stability, Problem based on thermal stability. **Analysis of transistor amplifier circuit using 'h' parameters -** Analysis of transistor amplifier circuit using 'h' parameters, Problem based on analysis of transistor amplifier.

UNIT V - FIELD EFFECT TRANSISTOR AND FET AMPLIFIERS

Junction Field Effect Transistor (JFET) - Introduction to field effect transistor, Terminal details of JFET, Classification of Field Effect Transistor (FET), Introduction of Junction Field Effect Transistor (JFET), Construction of N and P-channel JFET, Operation of JFET. **Characteristics of JFET -** JFET Parameters, JFET Characteristics, Advantages and Disadvantages of JFET over BJT, Features and applications of JFET. **Small signal analysis of JFET -** Small signal analysis of JFET, Approximate a.c. equivalent circuit, Common source amplifier with fixed bias, Analysis of common source amplifier with fixed bias, Problem to determine input impedance, output impedance and voltage gain. **MOSFET -** Introduction of MOSFET, MOSFET structure, Classification of MOSFET. **EMOSFET -** Construction of a N-channel enhancement MOSFET, Operation of enhancement MOSFET, Drain and transfer characteristics, Comparison of D-MOSFET and E-MOSFET, Comparison between N-Channel and P-Channel MOSFET. **DMOSFET -** Construction of depletion MOSFET, Operation of MOSFET, Drain and transfer characteristics. **MOSFET biasing -** Introduction, Operation of MOSFET, Biasing enhancement MOSFET, Biasing of depletion MOSFET. **FET amplifiers -** Introduction, Common Source (CS) amplifier, Common

Drain (CD) amplifier, Common Gate (CG) amplifier. **Generalized FET amplifier -** Generalized FET amplifier, CS amplifier with a unbypassed source resistance, CG amplifier, CD amplifier. **Biasing of FET -** Introduction, JFET with fixed bias, JFET with self bias (RS Bypassed), JFET with self bias (RS Unbypassed), JFET with voltage divider circuit (RS bypassed), JFET with voltage divider bias (Unbypassed RS). **FET as voltage variable resistor -** FET as a Voltage Variable Resistor(VVR). **Comparison OF FET and BJT -** Comparison OF FET and BJT. **Solved problems for JFET -** Problem to calculate the drain current, Problem to calculate drain current and transconductance, Problem to calculate the drain current and voltage, Problem to calculate source resistance, Problem to calculate gate source voltage.