

Chapter 1: Capacitance

Section 1. Isolated capacitors

- Definition of capacitance of isolated conductors
 - factors affecting the capacitance
 - capacitance of spherical conductor
- Connecting isolated conductors
 - charge redistribution for two conductors
 - charge redistribution for multiple conductors
- Energy stored in isolated conductors
 - work done in charging an isolated conductor
 - energy stored in terms of capacitance
 - heat generated in redistribution of charge on connecting two conductors

Section 2. Types of Capacitors

- Ideal design of capacitors
- Parallel plate capacitor
 - charge distribution
 - electric field between the plates
 - force between the plates
 - potential difference between plates
 - capacitance
 - work done in charging and the energy stored
- Electrostatic potential energy density
 - formula and justification for parallel plate capacitors
 - total energy in small volume
 - total energy in any volume with uniform or non-uniform electric field
 - self energy of charged systems
 - charged spherical conductor
 - charged spherical insulator
 - relation of self and interaction energy
- Spherical capacitor

- capacitance
- energy stored
 - region where energy is stored
 - using energy density and work done in charging
 - amount of energy stored
- Cylindrical capacitor
 - capacitance

Section 3. Simple Circuits

- Circuits with single capacitor and single battery
 - determination of charges
 - work done by battery in charging
 - energy stored in capacitors
 - heat dissipated in circuit
- Series and parallel combination
 - formula for equivalent capacitance
 - circuits extending to infinity
 - charge determination on each capacitor
- Changing connections
 - circuits with only capacitors
 - redistribution of charges and energy
 - heat dissipated and energy stored
 - connecting two charged capacitors with same or opposite polarity
 - circuits with capacitors and battery
 - variation in charges
 - heat dissipated
 - work done by battery
- Changing capacitance
 - by slowly increasing/decreasing separation between plates
 - charge flown, heat, work done by external agent

- short circuiting a capacitor
- Wheatstone bridge principle
 - finding equivalent capacitance
 - finding charges
 - changing connections

Section 4. Dielectrics

- Introduction
 - definition
 - effect on placement between two charges
 - amount of induced charge on dielectric surface
- Effects of dielectric in capacitors
 - formula modifications for
 - capacitance
 - induced charge on capacitor
 - electric field inside/outside dielectric
 - Isolated capacitors

- charge, potential, electric field, energy
- work done by agent in placing dielectric
- force on dielectric
- battery connected capacitors
 - charge, potential, electric field, energy
 - work done by battery
 - work done by agent in placing dielectric
 - force on dielectric
- Effects in circuits in removal/insertion of dielectric
 - Capacitance, Charge, potential difference Variations
 - work done by external agent and battery
 - heat generated in the process
 - force on dielectric

Chapter 2: Resistors and Electrical Circuits

Section 1. Current and Current Density

- Introduction
 - average and instantaneous current
 - graphs of charge and current
 - calculations for motion of continuous charge through a surface
- Current density
 - vector quantity

Section 2. Conduction in Metals

- Motion of free electrons in metals
 - random motion and drift motion
 - relation of current and drift velocity
 - relation of drift velocity and electric field
 - temperature dependence of the relations

- Ohm's law [Vector form]
 - the law and the constant terms (mobility, resistivity, conductivity)
 - comparison of various terms for current in variable cross-section
 - currents within solid materials
 - spherically symmetric charge flow
 - cylindrically symmetric charge flow
- Ohm's law [Scalar form]
 - the law and resistance
 - thermal coefficient of resistance
 - factors affecting resistance
 - resistance of different shapes

- cuboid along different directions
- cylinder and sphere
- cylinder of variable cross section

- equivalent resistivity

- Colour coding of resistors

Section 3. Simple Circuits

- Circuits with one resistor and battery
 - potential difference and current
 - power delivered by battery
 - formula for heat dissipated in resistors
- Ratings of Devices (fuse)
 - voltage ratings
 - power ratings
- Series and parallel combination calculations
 - of equivalent resistance
 - of current in different parts
 - of power dissipated in different parts
- Equivalent resistance of series and parallel combination of resistors

- Problems to find equivalent resistance and current in resistors

Section 4. Miscellaneous Circuits

- Wheatstone bridge principle
 - identification of wheatstone bridge
 - more than one bridge
- Simple symmetric circuits
 - disconnecting a connected wire [hexagonal circuits]
 - unbalanced but symmetric Wheatstone bridge
 - Cubical network of resistors
 - across body diagonal
 - across face diagonal
 - across adjacent corners
- nodal method
 - various branches meeting at a node
- Advanced Methods
 - Principle of superposition
 - Star delta transformation

Chapter 3: Electrical Devices

Section 1. Cell

- Introduction
 - Definition of emf
 - internal resistance
 - relation with potential difference
- Charging and discharging of cells
 - work done by cell
 - potential difference across the cell
- Maximum power dissipation theorem
- Grouping of cells
 - formula for series and parallel grouping

- current, voltage and power distribution in grouping

Section 2. Measuring Devices

- Galvanometer
 - construction of galvanometer
 - working of galvanometer
 - various sensitivity and its drawbacks
- Conversion of galvanometer into voltmeter
- Conversion of galvanometer into ammeter

Section 3. Experiments

- Ohm's law verification
 - Experimental details
 - Circuit and graphs

- Meter bridge experiment
 - Principle used and formula
 - possible variations in experiment
 - internal resistance of cell/jockey/wire
 - interchange of standard and unknown resistance
 - interchange of galvanometer and unknown resistance
- Potentiometer experiment
 - to compare emf of cells
 - to find internal resistance of cells

Section 4. RC Circuits

- RC circuits in initial and steady state
- RC circuits in transient state
 - Charging
 - equations for charge and current
 - graph and significance of time constant
 - Discharging
 - equations for charge and current
 - graph and significance of time constant