**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 contineous 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 brances 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