Chapter-01(Electrostatics)

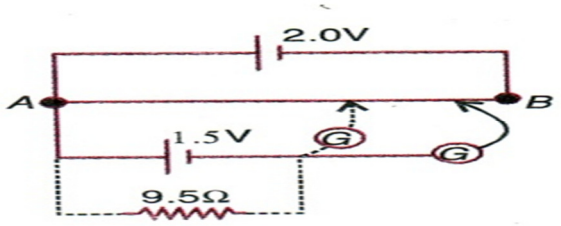
1. Define the term electric field intensity. Write its SI unit. Derive an expression for the electric field intensity at a point on the axis of an electric dipole.
2. State Gauss' theorem in electrostatics. Use it to obtain an expression for the electric field intensity at a point near a uniformly charged infinite plane sheet.
3. Derive an expression for the energy stored in a parallel plate capacitor, with air as the medium between the plates.
   A parallel plate capacitor of capacitance 100 μF is charged to 200 V. After disconnecting it from the battery, using an insulated handle, the distance between the plates is doubled. Find
   (i). Potential difference between the plates, and
   (ii). Energy stored in the capacitor, after separation between the plates has been increased.

4. Obtain the expression for the capacitance of a parallel plate capacitor.
   Three capacitors of capacitance C_1, C_2 and C_3 are connected (i) in series, (ii) in parallel. Show that the energy stored in the combination is the same as that in the parallel combination.
5. Derive an expression for the torque experienced by an electric dipole placed in an uniform electric field. Hence obtain the expression for the potential energy of the dipole.

Chapter-02(Current-electricity)

1. State the underlying principle of a potentiometer with the help of a circuit diagram . Describe a method to find the internal resistance of the primary cell.
2. A battery of emf $'E'$ and internal resistance $'r'$ gives a current of $0.5\ A$ with an external resistance of 12Ω and a current of $0.25\ A$ with an external resistance of 25Ω. calculate the internal resistance and *emf* of the cell.
3. State the principle of a potentiometer with the help of circuit diagram, explain how a potentiometer can be used to compare the emf's of two cells.
4. Two cells of *emfs* E_1 *and* E_2 *and internal resistances* r_1 *and* r_2 *are connected in parallel.* Derive an expression for the
   (i) *e m f* and (ii) internal resistance of a single equivalent cell which can replace this combination.

5. Figure shows a 2.0 V potentiometer used for the determination of internal resistance of 1.5 V cell. The balance point of the cell is open circuit is 76.3 cm. when a resistor of 9.5 Ω is used in the external circuit of the cell, the balance point shifts to 64.8 cm length of the potentiometer wire. Determine the internal resistance of the cell.



5. (a) Three resistors 1 Ω, 2 Ω, and 3 Ω are combined in series. What is the total resistance of the combination?
   (b) If the combination is connected to a battery of emf 12 V and negligible internal resistance, obtain the potential drop across each resistor.

Chapter-03(Magnetic Effects of electric current)

1. State Biot-Savart's law and show it mathematically. Find the magnetic field due to current carrying circular coil on its axial point.
2. Compare Dia, Para and Ferro magnetic substance on the basis of any three properties of these materials.
3. Find the magnetic field due to a solenoid having length L and number of turns N.
4. With the help of a neat and labeled diagram, explain the underlying principle and working of a moving coil galvanometer. What is the function of : (i) uniform radial field. (ii) soft iron core., in such a device?
5. Derive a mathematical expression for the force per unit length experienced by each of the two long current carrying conductors placed parallel to each other in air. Hence define one ampere of current.
   Explain why two parallel straight conductors carrying current in the opposite direction kept near each other in air repel?
6. Draw a neat and labeled diagram of a cyclotron. State the underlying principle and explain how a positively charged particle gets accelerated in this machine. Show mathematically that the cyclotron frequency does not depend upon the speed of the particle.

Chapter-04(EMI and Alternating current)

1. (a) Define the term 'impedance of series LCR circuit'. Derive a mathematical exp0ression for it using phasor diagram.
   (b) Obtain the resonant frequency of a series LCR circuit with L = 3.0 H, C = 32 μF and R = 10 Ω

2. With the help of a neat labelled diagram, explain the principle, construction and working of an a.c. generator.
3. Explain, with the help of a neat and labelled diagram, the principle, construction and working of a transformer.
4. What is induced emf? Write Faraay's law of electromagnetic induction. Express it mathematically. C conducting rod of length $'l'$, with one end pivoted, is rotated with a uniform angular speed $'\omega'$ in a vertical plane, normal to a uniform magnetic field $'B'$. Deduce an expression for the emf induced in this rod.
   In India, domestic power supply is at 220 V, 50 Hz, while in USA it is 110V, 50 Hz. Give one advantage and one disadvantage of 220 V supply over 110V supply.
5. Derive an expression for the self inductance of a long solenoid of length L and number of turns N.
6. State Lenz's rule and explain it obey the conservation of energy.
7. Find the phase relationship between voltage and current and power dissipation when an AC is applied to a pure inductance only.
8. What is Q factor of an LCR circuit?

Chapter-05 (Electromagnetic waves)

1. Write two applications each of (i) microwaves, (ii) infra-red waves, and (iii) radio waves.
2. Name the constituent radiation of electromagnetic spectrum which
   (a) is used in satellite communication.
   (b) is used for studying crustal structure.
   (c)is similar to the radiations emitted during decay of radioactive nuclei.
   (d) has its wavelength range between 390 nm and 770 nm.
   (e) is absorbed from sunlight by ozone layer.
   (f) produces intense heating effect**.**
3. Sketch a schematic diagram depicting electric and magnetic fields for an em wave propagating along z −direction.

Chapter-06 (Optics)

1. Show by a diagram the image formation of a point by a thin double convex lens having radii of curvature R_1 and R_2. Hence derive the formula $\frac{1}{f} = (n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$, where f is the focal length and is refractive index of material of the lens.
2. Draw a labeled diagram of a compound microscope when the image is formed at infinity. Deduce the expression for its magnifying power. How can the magnifying power be increased?
3. Draw a labeled diagram to show image formation in an astronomical telescope. Write an expression for its magnifying power. Why should the objective lens of such a telescope have large diameter?
4. Draw a labeled ray diagram of a compound microscope, showing the formation of image at the near point of the eye. Calculate the magnifying power of the combined microscope.
5. Show by a diagram the image formation of a point by a thin double convex lens having radii of curvature R_1 and R_2. Hence derive the formula $\frac{1}{f} = (n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$, where f is the focal length and n is refractive index of the material of the lens.
6. What are the coherent sources of light? State two conditions for two light sources to be coherent.
   Derive a mathematical expression for the width of interferences fringes obtained in Young's double slit experiment with the help of a suitable diagram.
7. Find the relation between $u, v\ and\ f$ for convex lens.

Chapter-07 (Dual Nature: Matter and Radiation)

1. Derive the expression for the de-Broglie wavelength of an electron moving under a potential difference of $V\ volts$. Describe Davisson the Germeer experiment to establish the wave nature of electron. Draw a labeled diagram of the apparatus used.
2. Explain the term "stopping potential" and "threshold frequency" in photoelectric emission. Draw a graph showing the variation of stopping potential with frequency of incident light in relation to photoelectric effect. Deduce an expression for the slope of this graph using Einstein's photo electric equation.
3. Define the term:
   (a) (i) Work function, (ii) threshold frequency and (iii) stopping potential, with reference to photoelectric effect.
   (b) Calculate the maximum kinetic energy of electrons emitted from a photosensitive surface of work function $3.2\ eV$, for the incident radiation of wavelength $300\ nm$.

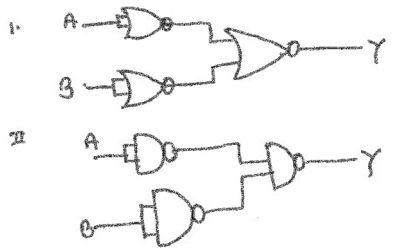
Chapter-08 (Atoms and Nuclei)

1. Draw a labeled diagram for α −particlescattering experiment. Give Rutherford's observation and discuss the significance of this experiment. Obtain the expression which helps us to get an idea of the size of a nucleus, using these observations.
2. Draw the graph to show variation of binding energy per nucleon with mass number of different nuclei.
   Given: mass of ${}^{40}_{20}Ca = 39.962589\ u$.
3. State the law of radioactive decay.
   Plot a graph showing the number of undecay nuclei as a function of time for a given radioactive sample having half life T.
4. (a) Two nuclei have mass numbers in the ratio $2:5$. What is the ratio of their nuclear densities?
   (c) Two nuclei have mass numbers in the ratio $27:125$. What is the ratio of their nuclear radii?

Chapter-09 (Semiconductor and Devices)

1. Explain the use of a $p-n$ junction diode as a rectifier. Draw the circuit diagram of a full wave rectifier and explain its working. Draw the input and output wave forms.
2. Distinguish between intrinsic and extrinsic semiconductors. Explain the formation of potential barrier and depletion region in a $p-n$ junction.

3. Identify the logic operation carried out by the circuit shown below and write a truth table.



4. Define logic gates. Why logic gates are used? What are the different types of logic gates, draw symbol and truth table of each gates?

Chapter-10 (Communications)

1. What is amplitude modulation? Discuss its advantages and disadvantages.
2. (a) Draw a block diagram of amplitude modulation.

   (b) Draw the block diagram of receiving antenna.

3. Define modulation index. What is the function of a repeater in a communication system?
4. What is the sky wave communication? Why is this mode of propagation restricted to the frequencies only up to few MHz ?