

I Electrostatics (8 marks)

1. Write any four properties of charges
2. Discuss the method of charging by Induction and charging by Conduction
3. State Coulomb's law in vector form
4. State Superposition principle of charge distribution
5. What is continuous charge distribution? Also define Linear, Surface and Volume charge density
6. What is Electric field? Write an expression for the electric field due to a point charge
7. What are Electric field lines? Write their properties. Also draw the electric field lines of a Positive charge, Negative charge, a system of two positive charges, a dipole, and uniform electric field
8. What is an electric dipole and dipole moment? Also write the SI unit of dipole moment
9. Derive an expression for the electric field due to dipole at any point on the (i) axial line and (ii) equatorial line
10. Derive an expression for the torque and force acting on a dipole placed in a uniform electric field
11. What is electric flux? Write its SI unit. When is flux positive and negative?
12. State and prove Gauss's theorem
13. Derive an expression for the electric field due to (i) infinitely long line charge (ii) a plane sheet of charge and (iii) a spherical shell of charge
14. What is electric potential? What is its SI unit?
15. Write the relation between electric potential and electric field
16. Derive an expression for the electric potential due to (i) point charge, (ii) system of charges and (iii) a dipole
17. Derive an expression for the potential energy of a system of (i) two point charges and (ii) a system of three charges
18. Derive an expression for the potential energy of a system of two charges placed in an external field.
19. Derive an expression for the potential energy of a dipole placed in a uniform field
20. What are equipotential surfaces? Write their properties. Also draw the equipotential surface of (i) a point charge (ii) a dipole (iii) a system of two like charges and (iv) uniform electric field
21. (i) Show that the electrostatic field inside a conductor is zero
(ii) Show that the net charge inside a conductor is zero under static conditions
(iii) Show that the electric field at the surface is normal to the surface of a conductor
(iv) Show that the potential at all the points on the surface and inside a conductor is constant.
(v) Show that the electric field at the surface of a conductor is σ/ϵ_0 .
(vi) What is electrostatic shielding?
22. Explain dielectric polarization and hence define Polarisation (P) and electric susceptibility
23. What is Capacitance? Write its SI unit. What is the principle of a parallel plate capacitor?
24. Derive an expression for the capacitance of a parallel plate capacitor with and with out a dielectric medium
25. Derive an expression for the energy stored in a parallel plate capacitor
26. Derive an expression for the effective capacitance of (i) series combination and (ii) parallel combination
27. Discuss the principle and working of a Van de Graff generator. What are its limitations?

II Current Electricity (7 marks)

28. Define drift velocity and relaxation time of electrons. Derive a relation between them.
29. Define electric current, current density and mobility. Derive an expression for electric current in terms of drift velocity and relaxation time
30. State ohms law. Define resistance, conductance, resistivity and conductivity and write their units
31. Give examples of non ohmic devices. Draw their V-I characteristics
32. What are colour code for carbon resistors?
33. Derive an expression for the series and parallel combination of resistors
34. What is temperature coefficient of resistance? Discuss the variation of resistivity with temperature for (i) metals (ii) alloys (iii) semiconductors and (iv) insulators
35. Define internal resistance, emf and terminal potential difference of a cell. Derive the relation between them during (i) charging and (ii) discharging of a cell.
36. Derive an expression for the net emf and internal resistance of two cells connected in (i) series and (ii) parallel
37. State Kirchhoff's laws
38. State and prove the principle of Wheatstone bridge
39. What is the principle of potentiometer? How it can be used to (i) Compare the emf of two primary cells and (ii) Find the internal resistance of a primary cell

III Magnetic effects of current and magnetism (8 marks)

40. Discuss Oersted's experiment which demonstrates the magnetic effect of electric current
41. State Biot –Savart law
42. Derive an expression for the magnetic field due to current carrying loop by applying Biot – Savart law
43. State Ampere's circuital law. Derive expression for the magnetic field due to (i) Infinitely long current carrying wire, (ii) Straight Solenoid and (iii) toroidal solenoid using Ampere's law
44. Give an expression for the force acting on a charge moving in a magnetic field
45. Explain the principle and working of a Cyclotron
46. Derive an expression for the force acting on a current carrying conductor placed in a magnetic field
47. Derive an expression for the force acting between two current carrying conductors placed in a magnetic field. Hence define ampere
48. Derive an expression for the torque and force acting on a current carrying loop placed in a magnetic field.
49. Explain the principle and working of a moving coil galvanometer. What is current sensitivity and voltage sensitivity
50. How can we convert a galvanometer to (i) Ammeter and (ii) Voltmeter.
51. Give an expression for the magnetic dipole moment of a current carrying loop. What is the unit of Magnetic dipole moment?
52. Derive an expression for the magnetic dipole moment of a revolving electron
53. What are magnetic field lines? Draw the magnetic field lines of bar magnet, straight solenoid and a current carrying loop
54. Derive an expression for the magnetic field at any point on the (i) axial line and (ii) equatorial line of a magnetic dipole
55. Derive an expression for the torque acting on a magnetic dipole placed in a uniform magnetic field.
56. Compare the magnetic field produced by a bar magnet and a current carrying straight solenoid
57. What are the elements of earth's magnetic field? Explain
58. Define magnetization, magnetic intensity and magnetic Susceptibility.
59. Write the properties of Dia, Para and Ferro magnetic materials. Give examples
60. What are electro magnets and permanent magnets? Give examples

IV. Electromagnetic Induction and Alternating currents (8marks)

61. Define Electromagnetic induction. What is Faraday's law of electromagnetic induction?
62. State and explain lenz's law. Show that lenz's law is in accordance with law of conservation of energy.
63. What is Motional emf? Derive an expression for the motional emf.
64. What are eddy currents? How these currents can be minimized? What are its applications?
65. What is Self induction? Derive an expression for the self inductance of a long solenoid
66. What is Mutual induction? Derive an expression for the mutual inductance of two long solenoids.
67. What is alternating current? Derive an expression for the average value and rms value of AC.
68. Derive expressions for the reactance or impedance and phase difference between emf and current in a circuit containing (i) inductor, (ii) capacitor, (iii) Series combination of L and R, (iv) Series combination of C and R, (v) Series combination of L, C and R
69. What is Resonance of LCR circuit? What is its condition?
70. What is Sharpness of Resonance and Quality factor?
71. Derive an expression for the power in AC circuits
72. What are LC oscillations? Explain qualitatively
73. Explain the principle and working of AC generator
74. Explain the principle and working of transformer. What are the two types of a transformer?

V. Electromagnetic waves (3 marks)

75. What is displacement current? Show that the displacement current in between the plates of a capacitor during charging is equal to the conduction current outside. Write Maxwell's equations.
76. Show that em waves are transverse in nature
77. What is electromagnetic spectrum? Write the properties and applications of different types of electromagnetic waves (radio waves, micro waves, infrared, visible, ultraviolet, X-rays, and gamma rays).

VI. Optics (14 marks)

78. What are the laws of reflection of light?

obtain an expression for energy density of an E.M. wave in terms of E & B fields.

79. What are spherical mirrors? Derive the relation between radius of curvature and focal length of spherical mirrors
80. Derive Mirror formula
81. What are the laws of refraction(Snell's law)
82. Explain the cause of early sunset and delayed sun set.
83. What is Total internal reflection? What are its conditions? Also define critical angle. *show that $n = \frac{1}{\sin i_c}$*
84. Explain the action of totally reflecting prisms, brilliance of diamond, optical fibers and the phenomena of mirage.
85. Derive the relation between the distance of the image and object when refraction takes place at a (i) convex spherical surface and (ii) concave spherical surface.
86. Derive Lens makers formula and Thin lens formula
87. What is magnification and power of a lens. Derive their expressions and write their SI units
88. Derive expressions for the focal length, magnification and power of thin lenses in contact.
89. What is angular dispersion and dispersive power?
90. Derive an expression for the refractive index of a material of a prism in terms of angle of minimum deviation.
91. What is scattering of light? What is Rayleigh's criteria for scattering?
92. Why (i) sky appears blue, (ii) Sun appears red during sunset and sunrise and (iii) clouds are white?
93. Explain the construction of Human eye, its image formation and accommodation.
94. What are the defects of vision? How these defects can be corrected?
95. Explain the construction and hence derive the expression for the magnification of a Simple Microscope.
96. Explain the construction and hence derive the expression for the magnification of a Compound Microscope.
97. Explain the construction and hence derive the expression for the magnification of a Refracting telescope.
98. Explain the construction and hence derive the expression for the magnification of a Reflecting Telescope.
99. What is a wave front? What are the different types of wave front?
100. What is Huygens' wave principle?
101. Derive the laws of reflection and refraction on the basis of wave theory of light
102. What are coherent sources of light
103. What is interference? What are the conditions of sustained interference? Write the condition for constructive and destructive interference in terms of phase difference and path difference.
104. Discuss Young's double slit experiment and hence derive expression for the width of bright and dark bands.
105. Discuss diffraction at a single slit and hence derive an expression for the width of central maximum.
106. What is resolving power of optical instruments? Derive expressions for the resolving power of a (i) Microscope and (ii) Telescope.
107. What is polarization of light?
108. Explain polarization of light by reflection and polarization by scattering
109. What is Brewster's law?

VII. Dual Nature of Matter and Radiation (4 marks)

110. What is Photoelectric effect?
111. Explain Hertz and Lenard's observation about photo electric effect.
112. Discuss the variation of photocurrent with (i) Intensity of incident radiations, (ii) Anode potential for different intensity of light and (iii) Anode potential for different frequency of light.
113. What is cut off potential? Discuss the variation of cut off potential with the frequency of incident radiation and hence define cut off frequency. Also discuss a method to find Planck's constant using the graph.
114. What is wave nature of matter? Write de Broglie relation
115. Explain Davisson -Germer experiment

VIII. Atoms & Nuclei (6 marks)

116. Explain Alpha scattering experiment and define Impact parameter
117. What is Rutherford's atomic model?
118. What are Bohr Postulates? Derive expression for the radius and speed of electron revolving in the n^{th} orbit hydrogen atom.
119. Derive an expression for the energy of electron in the n^{th} orbit hydrogen atom. Hence explain the origin spectral series of hydrogen atom. Also define Rydberg constant.
120. Give an expression for the size of nucleus and hence show that nuclear density is constant
121. Define isotopes, isobars and isotones. Give examples
122. What is radioactive decay law?

123. Define Half life period and Mean life. Derive their expressions
124. Write the equations which represent alpha decay, beta decay and gamma decay. Also write examples
125. Write the properties of alpha, beta and gamma radiations
126. What is mass defect and binding energy?
127. What is binding energy per nucleon? Give its expression in terms of mass defect.
128. Discuss the variation of Binding energy per nucleon with respect to mass number.
129. What is nuclear fission and fusion? Give examples. Write the expression for the energy released in a nuclear reaction in terms of (i) mass defect and (ii) binding energy per nucleon.

IX. Electronic Devices (7 marks)

130. Define intrinsic semiconductor, n type and p type semiconductors. Draw the energy band diagram.
131. What is a pn junction diode? Hence define potential barrier and depletion region
132. Discuss the forward and reverse characteristics of diode
133. Discuss the action of diode as a (i) half wave rectifier and (ii) full wave rectifier.
134. Discuss the action and I-V characteristics of LED, photo diode and solar cell.
135. What is a zener diode? Discuss the action of zener diode as a voltage stabiliser
136. What are the two types of a transistor? What is transistor action? Explain the forward characteristics, reverse characteristics and current amplification factor of common emitter transistor.
137. Discuss the action of transistor as a switch.
138. Explain the working of common emitter amplifier and write its characteristics. Show that the input and output of the amplifier are out of phase.
139. Explain the action of transistor as oscillator
140. Write the Boolean algebra, Truth table and the symbol of OR, AND, NOT, NAND and NOR gates

X. Communication Systems (5 marks)

141. What are the elements of a communication system? Draw the block diagram
142. Define Transducer, Signal, Noise, Transmitter, Receiver, Attenuation, Amplification, Range, and repeater in communication systems.
143. Define bandwidth of Signals and transmission medium. Give examples
144. What are ground waves, sky waves and space waves?
145. What is line of sight (LOS) and satellite communication? Derive an expression for the range of communication in terms of height of antenna and radius of earth.
146. What is modulation? What is the need of modulation?
147. What is Amplitude Modulation? Show graphically. Derive an expression for the Amplitude modulated wave and hence define modulation index and sidebands
148. Discuss the production of Amplitude modulated wave.
149. What are the important parts of a Receiver?
150. What is detection of Signals? Explain the method of detection of Amplitude modulated wave.