PHY4C04:ELECTRICITY, MAGNETISM AND NUCLEAR PHYSICS

A Part

1. Show that coulomb force obeys Newton's third law of motion.
2. Two electric field lines never intersect. Why
3. State and explain Coulomb's inverse square law in electrostatics
4. Derive the relation between the electrical potential (V) and electric field (E)
5. Describe an expression for the electric potential due to a point charge
6. State and explain superposition principle.
7. What is the differential form of Gauss's Law?
8. Define electric field at a point. What are its units.
9. Define electric potential energy of a system of charges. Write down an expression for the P.E of a system of two point charges seperated by a distance r.
10. State the principle of consevation of electric charge. Give examples.
11. What are equipotential surfaces. Give Examples.
12. Define electrical potential at a point in an electric field. What is its unit.
13. Define electric potential energy.
14. A body has a charge of 1C. Calculate the number of excess electrons on the body.
15. Define electric field lines. State their properties.
16. Define Electric flux. How it is related to electric field
17. It is safer to sit in a car or a bus during lightning rather than to stand under a tree or on a open ground. Why?
18. Write down the Coulomb's inverse square law in vector form and explain the symbols.
19. state Gauss's Law
20. State and Explain Gauss's law
21. what is dielectrics? Distinguish between a polar and a non polar dielectrics.
22. What are dielectrics? Define dielectric constant of a meterial
23. Define dielectric Strength.
24. Define dielectric Strength.
25. What is electrostatic shielding? Mention one practical application.
26. What is parallel plate capacitor? What is its capacitance.
27. A parallel plate capacitor has a capacitance of 1F. The plates are separated by 1 cm. then what must be the area of each plate.
28. what are the facors on which the capacitance of a parallel plate capacitor deponds.

29. Derive an expression for energy stored in a capacitor.
30. Explain the term capacitance of a capacitor. What is its unit.
31. Define 1 farad.
32. Distinguish between a capacitor and a conductor.
33. Define Current density.
34. Define conductance and conductivity.
35. What are the fators on which resistance of a conductor depend? Hence define resistivity.
36. How does the resistivity of a material vary with temperature.
37. Show that resistivity of a material of a conductor is inversely proportional to the relaxation time.
38. Define electric current density. How is it related to the drift velocity of electron.
39. what do you mean by terms drift velocity and relaxation time. Derive a relation between them.
40. State and explain Ohm's law
41. Define temperature coefficient of resistance.
42. What is resistance? Define its unit?
43. What are superconductors? Give examples.
44. What is superconductivity.
45. Give four applications of superconductivity.
46. What is the cause of superconductivity.
47. Define Meisner effect. Explain the properties of superconductors.
48. Draw a labelled diagram of a potentiometer experiment to measure the resistance of a coil
49. What is meant by shunt resistance. Derive its expression.
50. How a galvanometeris converted into an voltmerter.
51. How a galvanometeris converted into an ammeter.
52. What is a potentiometer. Give its principle.
53. What is a Carey foster bridge. What is its principle.
54. How will youn determine the temperature coefficient of resistance graphically by knowing resistance at 0 degree celsius and t degree celsius.
55. Draw a labelled diagram of a Carey foster experiment to measure the resistance of a coil.
56. What is magnetic mapping.
57. What are the magnetic elements of earth? Define them.
58. Define the terms (i) Isogonic lines (ii) Isoclinic lines
59. Derive the relation between magnetic elements of earth.

60. Define (i) Retentivity (ii) Coercivity
61. What is meant by hysteris loss
62. Give properties of diamagnetic substances.
63. What are ferromagnetic substancs? Give examples.
64. What is hysterisis
65. Give properties of ferromagnetic substances.
66. Give properties of paramagnetic substances.
67. What is B - H curve
68. What are paramagnetic substancs? Give examples.
69. What is the principle of deflection magentometer? How can we set up deflection magnetometer in Tan A position?
70. Distinguish between soft and hard magnetic materials
71. What is the resultant magenetic field of earth at a place where angle of dip is 60^0 and horizontal intensity is 0.3G?
72. Distinguish between Tan A and Tan B positions of deflection magnetometer
73. What is the principle of deflection magentometer? How can we set up deflection magnetometer in Tan B position?
74. How can we compare the magnetic moments using Searle's vibration magnetometer?
75. Define reduction factor of TG. How does the sensitivity of TG depend on its reduction factor?
76. What is the principle of tangent galvanometer?
77. Magnetic moment of neutron is not zero even though its electric charge is zero.Why?
78. The neutron proton diagram for nucleids with A<20 is a straight line. But for nucleids with A>20 the curve departs from the stability curve. Give reason
79. Nuclear forceis an exchangeforce.Explain
80. What is nuclear magneton? Why is it lesser than Bohr magneton?
81. Mention the inferences that can be obtained from the binding energy curve.
82. How nucleus is stable?
83. What do you mean by binding energy curve? Which of the atomic nuclei is the most stable?
84. The boron isotope B-12 is unstable while the carbon isotope C-12 is stable.Explain
85. Nature prefers evev-even stable nuclei.Why?
86. Define mass defect. What is the expression for mass defect of a nucleus?
87. What do you mean by saturation property of nuclear forces?
88. Write down the fission reaction of U-235. How much energy is released per fission

89. Define chain reaction.Under what condition is this reaction is said to be critical
90. Distinguish between nuclear fission and fusion.
91. Why do we need slow neutrons to cause nuclear fission? Can a slow proton cause fission of any heavy nuclei?
92. Controlled nuclear reaction is difficult in practice-why?
93. Write down the activity law of radioactive decay of a sample
94. What are the features of radioactivity?
95. Define half life and mean life of a radioactive material. How is it related to decay constants?
96. Which of the decay particleemitted during radioactive phenomenon has highest penetrating power? Why?
97. Write a note on carbon dating
98. Mention 4 properties of beta rays
99. What changes do occur in the mass number and atomic number of radionucleide during positive beta decay?
100. The helium isotope $^{6}_{2}He$ is unstable. What mode of decay is possible for this isotope?
101. What are the major haards of nuclear radiations?
102. Mention any two methods of disposal of nuclear wastes
103. Define the working principle of a linear accelerator
104. What are the limitations of a linear accelerator
105. Explain the need for particle accelerators and mention oneamong them
106. What is the advantages of cyclotron over linear accelerator?
107. Define annihilation of matter?
108. What is meant by cascade theory of cosmic rays?
109. What are Cosmic rays?
110. What are Primary and Secondary cosmic rays?
111. Define the process pair production and how it differs from annihilation?
112. State Pauli's exclusion principle and define the properties of the elementary particles which obey Pauli's exclusion principle
113. Leptons are more elementarythan others', comment on this statement.
114. What are Leptons? Discuss the decay mode of Leptons
115. Explain the concept of colour in quark theory
116. What are Hadrons? Give example
117. What are the 3 main observations that strongly support Big-Bang model of universe

118. Explain briefly about LHC.

119. The idea of Higgs bosons provides a satisfactory solution and fitted well with the established theory',Comment on this statement.

120. What are bosons and fermions?

B Part

121. Define electric potential and derive the expression for electric potential due to a point charge.

122. Define Electric potential energy. Derive the expression for the potential energy of a pair of charges

123. show that Coulombs Law obey Newton's third law.

124. Derive the relation between electric field and potential.

125. state and explain Coulomb's law. Write down the Coulomb's inverse square law in vector form and explain the symbols.

126. If the potential in the region of space near a point (-2,4,6) m is $V=(60x^2+60y^2)$ volt. Find the components of electric field at that point.

127. State and explain Superposition principle.

128. Find the field at a distance 0.1m from a point charge of 0.2 micro coulomb.

129. Calculate the coulombian force between two alpha particles separated by a distance of 3.2 x 10^-15 m.

130. Define Electric field lines. Explain its properties.

131. What are the properties of Electric Charges.

132. Two positive point charges which are 0.1 m apart repel each other with a force of 18 N. if the sum of the charges be 9μC. Calculate the charges.

133. Show that electric field due to a plane sheet of charge is independent of distance.

134. Show that a charged soap bubble shows a small increase in size.

135. Derive the expression for electrostatic pressure. What is its unit and direction.

136. Prove Coulomb's law from Gauss's law.

137. Derive the expression for electric field intensity due to two parallel sheets of charge.

138. State and prove Gauss's law in electrostatics.

139. State and derive Coulomb's theorem.

140. What is meant by electrostatic shielding. Give its practical application.

141. write a shot note on Dielectrics

142. Discribe the behaviour of Dielectrics in electrostatic fields.

143. Derive an expression for the capacitance of a cylindrical capacitor.

144. Show that the capacitance of a parallel plate capacitor increases when dielectric slab is introduced between parallel plates of the capacitor.

145. Derive the expression for the capacitance of parallel plate capacitor
146. Discribe the principle of a Capacitor.
147. Derive the expression for the energy stored in the capacitor and energy density in electric field.
148. Derive the force between the plates of a capacitor.
149. Derive an expression for the capacitance of a spherical capacitor.
150. Show that the capacitance of a parallel plate capacitor increases when conducting slab is inserted between parallel plates of the capacitor.
151. A 12 pF capacitor connected to a 50 V battery. How much electrostatic energy is stored in the capacitor?
152. Show that resistivity of a material of a conductor is inversely proportional to the relaxation time.
153. Define electric current density. How is it related to the drift velocity of electron.
154. A current of 5 ampere is passing through a metallic wire of cross sectional area 4 x 10^-3 m2. if the density of the charge carrier in the wire is 5 x 10^26 m-3. find the drift speed of electrons.
155. write a shot note on superconductivity. Give its applications
156. Explain in detail how a potentiometer is used to measure the resistance of a coil.
157. A galvanometer has resistance of 30 ohm and current of 2 mA is needed to give full scale deflection. What is the resistance needed and how is it to be connected to convert the galvanometer into(a) an ammeter of 0.3 amperes range (b) into a voltmeter of 0.2 V range.
158. With neat diagram explain the conversion of galvanometer into ammeter.
159. With neat diagram explain the conversion of galvanometer into voltmeter.
160. With the help of neat diagram , explain the experiment to measure the resistance of a coil using Carey Foster Bridge.
161. What is a Carey foster bridge. What is its principle.
162. What are the magnetic elements of earth? Define them. Derive the relation between magnetic elements of earth.
163. Derive the relation between relative permeability and magnetic susceptibility.
164. Distinguish between Dia, para and ferromagnetic materials.
165. Explain Hysterisis, B-H curve and Hysterisis loss
166. In tan A position a short magnet is placed at a distance d1 from the centre of the compass box of a deflection magnetometer. When the same magnet is placed at a distance d2 from the compass box in tan B position of the magnetometer, the deflection remains same. Find the ratio(d1/d2)
167. Explain the theory of measuring very small currents using a tangent galvanometer.Define the reduction factor of this galvanometer
168. Define binding energy of a nucleus. Show that the minimum energy of a gamma ray photon to split deutron into a free neutron is 2.23MeV. The mass of deutron nucleus is 2.013553 u
169. What are nuclear forces? Explain its properties

170. Find the binding energy of an alpha particle. Mp=1.007276 u, Mn=1.008665 u,Mass of helium nucleus is 4.001506 u.

171. Estimate the radius and density of C-12 nucleus.(R0=1.2 fm)

172. Draw the binding energy curve. Explain nuclear fission and fusion using this curve

173. The mass of $^{7}_{3}Li$ =7.016004u, mass of $^{6}_{3}Li$=6.015125 u and the mass of neutron is 1.008665 u. Calculate the binding energy of $^{7}_{3}Li$ nucleus.

174. Define nuclear fusion. Explain the proton-proton cycle taking place in the sun.

175. What are the conditions required for the fusion reaction of nuclei?Explain the fusion reaction involving carbon cycle in stars.

176. Define nuclear fusion. Explain the phenomenon on the basis of liquid drop model of nucleus.

177. What is the role of a moderator in a nuclear reactor?

178. Explain the theory behind Hydrogen bomb.

179. explain the basic principle and working of a nuclear reactor

180. Estimate the age of a wood from the ruins of an ancient dwellings if it has a C14 activity of 13 disintegrations per minute per gram. The 14C activity of living wood is 16 disintegrations per minute per gram and halflife perod of 14C is 5760 years

181. A certain radioactive element has a half life of 20 days. How long will it take for 3/4 of the atoms orginally present to disintegrate?

182. Determine the amount of having activity equal to 5 millicurie. The half life of Po is 138 days

183. Define activity of a radioactive specimen. If half life of radon-222 is 3.8 days, find the activity of 1.00mg of radon.

184. Explain the five modes of radioactivity with transformation equations for a radioactive isotope.

185. The half life of a radioactive sample is 4 days. What fraction of 1 gm sample will remain after 20 days.

186. Write a note on Nuclear waste disposal

187. What are the effects of nuclear radiations?

188. What are particle accelerators?. Define the working principle of a linear accelerator

189. What are the advantages of cyclic accelerators over a linear one?

190. The magnetic field strength in a 20 MeV proton cyclotron is 2T. What is the required frequency of the oscillator controlling the potential of the Dees? Also find out the diameter of the cyclotron

191. Write a note on Cosmic rays? Discuss the lattitude and longitude effect of cosmic ray shower.

192. Explain Cosmic ray shower

193. Explain how particles get their characteristic masses

194. State whether this reaction is possible or not.Check the quantum numbers are conserved or not.

$$n \rightarrow p + e^{-} + \upsilon_{e}^{-}$$

195. Explain the quark hypothesis

196. Write a short note on hadrons.

197. Complete the following reaction and verify the conservation of baryon number and electron lepton number
$n \rightarrow$.....+ e^- +$\bar{\nu}_e$

198. Is the following reaction possible based on conservation of baryon number?
Λ^0---------p+ π^-

199. Write a note on the orgin of universe

C Part

200. State and explain Gauss law. Derive the expression for electric field intensity due to two parallel sheets of charge.

201. State and explain Gauss's theorem in electrostatics. Find out the field due to a uniform plane sheet of charge.

202. Derive the expression for the force between the plates of a parallel plate capacitor, energy stored in the capacitor and energy density in electric field inside the capacitor.

203. Explain the terms capacitor and capacitance. Name and unit of capacitance. Obtain the expression for the capacitance of a parallel plate capacitor.

204. What is a Capacitor. Derive the expression for the capacitance of parallel plate capacitor.

205. What is meant by a galvanometer? With a neat diagram explain the conversion of galvanometer into voltmeter and into ammeter

206. Explain the conversion of galvanometer to ammeter and voltmeter with the help of diagrams and neccessary equations .

207. What is a potentiometer. Give its principle. Explain in detail how a potentiometer is used to measure the resistance of a coil.

208. What is a Carey foster bridge. What is its principle. With the help of neat diagram , explain the experiment to measure the resistance of a coil using Carey Foster Bridge.

209. Explain the magnetism of earth and the magnetic elements.

210. a) Explain ferromagnetism and the concept of domains
b) Draw the ferromagnetic hysteresis curve and explain it's points.

211. Discuss the theory of deflection magnetometer. Determine the moment of a magnet by setting the magnetometer in Tan A and Tan B positions.

212. Discuss the principle of deflection magnetometer to find the moment of the magnet in Tan A, Tan B and Tan C positions.

213. a)Explain the theory of vibration magnetometer. With the help of Searle's vibration magnetometer,how can we find the magnetic moment of a bar magnet? b) How can we compare earth's horizontal magnetic fields at different places using Searle's vibration magnetometer?

214. Write the properties of nuclear forces and explain breifly Nuclear fission and fusion?

215. What is a nuclear reactor? With the help of a diagram explain different sections of the reactor and its working.

216. a) Explain the phenomenon of radioactivity. Compare the properties of alpha,beta and gamma radiations

217. Give an account of the law of disintegration of radioactive substances. Deduce from this law the value of a) half life;b) mean life

218. Explain the five decay modes and the general properties of radiations that are emitted in differenent decays.

219. a) With a neat diagram explain the working principle of a linear accelerator. b) Derive an expression for the final kinetic energy acquired by the accelerated particles. C) What are the limitationsof this accelerator

220. Briefly describe the different types of particle accelerators according to the shape and path of the particle.

221. a) With a neat diagram explain the working principle of a cyclotron. b) Derive an expression for the final kinetic energy acquired by the accelerated particles

222. (a) Explain the classification of elementary particles
(b) Which of the following reactions can occur? State the conservation principle violated by the others
(i) Λ^0----------$\pi^- + \pi^+$
(ii) Υ+n--------- π^-+p

223. a)Discuss the conservation laws obeyed by the elementary particles.b)Classify various types of quark and their properties. c) Write the quark structure of protons and neutron

224. Discuss in detail the classification of elementary particles based on their spin and respond to strong interaction

D Part

E Part