CC19PPHY3C11:SOLID STATE
PHYSICS A Part

1. Write note on glide plane and screw axis .
2. Explain the concept of unit cell.
3. Explain Weigner-Seitz primitive cell.
4. Explain the concept of basis and lattice point.
5. Explain crystal planes and crystal directions.
6. Comment on the Bravais lattices of 3-D systems.
7. What is meant by translation operation in a crystal?
8. What are miller indices and how are they determined?
9. What is meant by Bravais lattices? Explain the Bravais lattices of 2-D planes.
10. What is the difference between a crystal lattice and a reciprocal lattice.
11. Briefly explain HCP structure.Give examples.
12. Derive the atomic packing fraction of BCC structrure
13. What is atomic packing fraction. Explain the concept of close packed structure.
14. Explain the structure of NaCl crystal.Give some examples of crystals showing the same structure.
15. Write notes on packing fraction,coordination number and planar density.
16. Derive the atomic packing fraction of HCP structure
17. What is meant by interplanar spacing?Obtain an expression for it.
18. Derive the atomic packing fraction of FCC structure
19. Explain the crystal structure of diamond
20. Explain the concept of reciprocal lattice and give the condition for X-ray diffraction using reciprocal lattice.
21. Derive Bragg’s equation .
22. Explain the concept of brillouin zone.
23. What is laue equation?
24. Write note on Ewald constructions.
25. Derive the Bragg’s diffraction equation using reciprocal lattice.
26. What are Brillouin zones? How are they related to the energy of an electron in a metal?
27. Explain how the first Brillouin zone for a two dimensional reciprocal lattice is constructed.
28. Explain the concept of reciprocal lattice
29. Explain the term cohesive energy and electron affinity.

30. Show that Madelung constant for the one-dimensional chain is given by $\alpha = 2 \ln 2$.
31. Explain ionic cohesive energy.
32. What is Madelung interaction? Deduce the value of Madelung constant in a linear lattice.
33. Explain the forces which play active part in the formation of inert gas crystals.
34. What are the distinguished characteristics of metallic bonds?
35. Explain with examples different types of bonding in solid materials.
36. What is a phonon? Explain the term phonon momemtum.
37. Explain the quantization of lattice vibrations
38. What are phonons?Explain their significance.
39. With the help of a dispersion diagram, explain the forbidden band and its significance for a diatomic lattice.
40. What are phonon modes?
41. Explain the inelastic scattering of neutrons by a crystal lattice
42. Distinguish between normal process and umclapp process.
43. Define acoustic and optical phonons.
44. Draw the dispersion relation of vibration of crystal with monatomic basis.
45. Explain how imperfections effect thermal conductivity of a specimen.
46. Explain thermal conductivity in solids
47. Derive the expression for Einstein model of heat capacity of a material.
48. What are the merits of Debye model over Einstein's model of specific heat capacity?
49. Explain the difference between Einstein and Debye Model of specific heats.
50. Give a qualitative derivation of electronic heat capacity.
51. What are the salient features of quantum theory of specific heat of solids?
52. Explain the concept of density of states.
53. Qualitatively explain the heat capacity of an electron gas.
54. Describe the expression for Fermi energy and Fermi velocity using Sommerfield theory.
55. What are the drawbacks of classical free electron theory?
56. What is meant by Fermi energy and Fermi momentum?
57. Derive Ohm's law.
58. State and prove Bloch theorem
59. Explain Hall effect.
60. What is Wiedmann-Franz law and explain its significance.

61. Explain the formation of energy bands in nearly free electron model
62. State central equation and explain its significance.
63. Explain the formation of energy gaps in brillouin zone boundaries.
64. How does band overlap result in the formation of metals.
65. Explain how materials become classified as metals and insulators using band theory.
66. What is direct energy gap ? Explain how phonos are involved in materials with indirect energy gap.
67. Explain holes.
68. Briefly describe the properties of holes.
69. Explain the physical significance of effective mass
70. Explain the concept of effective mass of electrons.
71. Explain the formation of n an p type semiconductors.
72. State and explain the law of mass action
73. Derive the expression for intrinsic carrier concentration of a pure semiconductor.
74. Explain the concept of intrinsic mobility.
75. Explain thermoelectric effects in semiconductors.
76. Distinguish between direct band gap and indirect band gap semiconductors.
77. Derive the Clausius-Massotti relation.
78. Derive an expression for dipolar polarisability.
79. Write a short note on ionic polarisability.
80. Briefly explain the frequency dependance of total polarisability.
81. Write a short note on electronic polarisability.
82. What are ferrites?In what ways are they superior to ferromagnetic materials?
83. Write a short note on ferroelectricity and ferroelectric crystals.
84. Write down the properties of $BaTio_3$ as a ferroelectric.
85. What is meant by order disorder type of ferroelectrics? Explain with examples.
86. Explain polarization catastrophe.
87. Write a short note on ferroelectricity.
88. What do you mean by displacive type ferroelectrics?
89. Write a short note on piezoelectric materials.
90. Explain first order phase transition based on Landeau theory.
91. Write down the differences between first order and second order phase transitions.

92. Briefly explain antiferroelectricity.
93. Explain second order phase transition based on Landeau theory.
94. Write a short note on ferroelectric crystals and ferroelectric domains.
95. Write down the applications of piezoelectric crystals.
96. Explain Hunds rules with a suitable example.
97. Write a short note on paramagnetism
98. Write a short note on diamagnetism.
99. Explain the quenching of orbital angular momentum for iron group ions.
100. Find the ground state of Cr3+ ion with the help of Hunds rules.(The 3d shell is partially filled and has 3 electrons)
101. What is the essential difference between the classical theory and quantum theory of paramagnetism?
102. Explain the cause of hysteresis phenomenon in ferromagnetic materials.
103. Explain the processes of domain magnetisation.
104. What are spin waves?
105. Explain why and how the ferromagnetic domains are formed?
106. Write a short note on antiferromagnetism.
107. Write a short note on ferrimagnetism.
108. Explain the difference between the terms curie temperature annd Neel temperature.
109. Explain Neel's theory of antiferromagnetism.
110. What is the Curie-Weiss law? Explain its significance.
111. Explain the process of spontaneous magnetization in ferromagnets.
112. Explain hysteresis in magnetic materials.
113. Discuss the variation of spontaneous magnetisation with temperature for ferromagnetic materials.
114. Draw a typical B-H loop and describe the different magnetisation processes.
115. Explain the variation of susceptibility with temperature for antiferromagnetic materials.
116. Write a short note on magnons in ferromagnets?
117. Describe the Heisenberg's exchange interaction.
118. Explain Neel's theory of ferrimagnetism.
119. What is exchange interaction? How does it help to explain magnetism in iron group of atoms?
120. Briefly explain the origin of domains.
121. Write a short note on ferromagnetism.
122. Briefly explain the exchange interaction leading to ferromagnetism in materials.

123. Give an account of Heisenberg interpretation of Weiss field.

124. Explain any 2 thermal properties of superconductors.

125. Write a short note on superconductivity.

126. Explain the occurrence of energy gap in a superconductor.

127. Differentiate between Type I and Type II superconductors.

128. How does entropy and specific heat of superconductors differ from that of normal conductors?

129. Briefly explain isotope effect.

130. Briefly explain Meissner effect in superconductors.

131. What are cooper pairs? How are they formed?

132. Derive the London equations.

133. Explain the concept of BCS ground state.

134. Briefly explain the concept of coherence length in superconductivity.

135. Give a qualitative description of the BCS theory.

136. How do London equations lead to Meissner effect?

137. Explain london penetration depth in superconductivity.

138. Differentiate between a.c Josephson tunneling and d.c Josephson tunneling.

139. Explain HTS and cuprates.

140. What do you mean by quantization of flux in superconductivity?

B Part

141. Explain symmetry elements in crystals. Describe the various types of symmetry elements and symmetry operations of a cubic crystal.

142. Derive the packing fraction and explain the structure of diamond and FCC .

143. Explain the structure of NaCl crystal and diamond crystal.

144. Explain Packing density or packing factor in crystals.Find out the packing fraction for FCC,BCC and HCP structures.

145. Explain the concept of reciprocal lattice and obtain Bragg's law in reciprocal lattice.

146. What is meant by Madelung interaction? Discuss the nature of cohesion and obtain expression of cohesive energy in ionic crystals

147. Show the dispersion relationship of the propagation of waves through the monatomic basis crystals.

148. Discuss the vibrational modes of a lattice with one atom per primitive cell.

149. Discuss the vibrational modes of a lattice with two atoms per primitive cell.

150. Discuss the theory of vibration of a diatomic lattice. Bring out the dispersive relation and sketch the graph.

151. Explain the formation of forbidden energy gap in the dispersion relation of the vibration of crystals with diatomic basis

152. Derive the Debye's law of specific heat capacity of a solid. Compare it with Einstein's theory.

153. Derive the expression for specific heat using Debye model.

154. Derive Einstein and Debye model equations of lattice specific heat. How do these models agree with experimental results?

155. Derive the expression for heat capacity of electron gas.

156. (a). Discuss how electronic heat capacity of a metal is described by free electron theory. (b). What is Hall effect? Deduce expression for Hall coefficient.

157. Explain the significance of Kronig- Penny model. Neatly sketch the band formation.

158. Describe the Kronig- Penny model with necessary theory

159. What is meant by Bloch function? Discuss the formation of allowed and forbidden energy band on the basis of Kronig-Penny model

160. Explain the failures of "free electron theory". Describe with necessary theory the Kronig-Penny model and show how the formation of bands is explained in this theory.

161. What is Bloch function? Discuss the formation of allowed forbidden energy bands on the basis of Kronig-Penney Model.

162. Discuss the Kronig-Penney model for the motion of an electron in a periodic potential

163. Derive an expression of carrier concentration of electrons and holes in an intrinsic semiconductor.

164. What is meant by Polarization mechanism in dielectrics? Discuss the different polarization mechanisms in dielectrics and explain their temperature dependence.

165. Derive Lorentz relation considering various types of electric fields related to an atom.

166. Explain Landeau theory of phase transitions.

167. Give an account for the quantum theory of paramagnetism and discuss low and high temperature cases.

168. Explain the origin of diamagnetism in materials. Obtain an expression for diamagnetic susceptibility using the Langevin's theory.What is the significance of negative susceptibility?

169. Obtain Curie's law using quantum theory of paramagnetism.

170. Distinguish between Ferro and Antiferro magnetism. Obtain an expression for temperature variation of spontaneous magnetization in a ferromagnet. What conclusion may be drawn from the plot of spontaneous magnetization verses temperature.

171. Describe the Neel's model to explain antiferromagnetism. How does this model account for the difference between the Neel temperature and the Curie-Weiss temperature?

172. Discuss Weiss theory of ferromagnetism. Explain hysteresis curve and transition between domains.

173. Explain Weiss theory of ferromagnetism. What is the Heisenberg interpretation of the Weiss field?

174. Give an account of the Weiss theory of ferromagnetism. Discuss the temperature variation of spontaneous magnetisation.Explain hysteresis on the basis of this theory.

175. Derive the London equations and explain penetration depth in superconductors .How does its solution account for Meissner effect?

176. Explain the BCS theory of superconductivity in detail.

177. Explain the quantization of magnetic flux in a superconducting ring.

178. Give an account of a.c Josephson effect effect with relevant theory.

179. Give an account of d.c Josephson effect effect with relevant theory.

C Part

180. An orthorhombic crystal has a ratio a: b: C = 0.429:1:0.377. Find the miller indices of the faces whose intercepts are (i) 0.214: 1: 0.188 and (ii) 0.429: α : 0.126

181. A plane makes intercepts of 1Aº, 2Aº, 0.5 Aº on crystallographic axes of orthorhombic crystal with a:b:c = 3:2:1. Determine Miller indices of this plane.

182. Show that for simple cubic lattice $d_{100} : d_{110} : d_{111} = (6)^{1/2} : (3)^{1/2} : (2)^{1/2}$

183. Lead has atomic density 11.35 gm/cm^3 and atomic mass 205 amu. Calculate the number of atoms per m^3 in lead.

184. Calculate the maximum radius of an atom that can be placed in between two bcc atoms in a bcc unit cell.

185. Zinc has hcp structure. The height of the unit cell is 0.494 nm. The nearest neighbor distance is 0.27 nm. The atomic weight of Zn is 65.37. Calculate the volume of the unit cell and density of Zn.

186. Calculate the density of atoms in (100), (110) and (111) planes of BCC Barium whose lattice parameter is 5.02 A^0.

187. Show that the reciprocal lattice for a bcc lattice is a fcc structure and vice versa.

188. Gold (fcc) has density of 19.3 g/cm^3 and atomic weight of 197.0. Calculate number of gold atoms per cm^3 and length of cube edge.

189. Calculate the maximum radius of an atom that can be placed in between two bcc atoms in a bcc unit cell.

190. Copper has FCC structure and the atomic radius is 1.278 AU. Calculate its density. Atomic weight of copper = 63.54 (U2)

191. Lattice constant of unit cell of alpha iron is 0.287 nm. Find the number of atoms per mm^2 of planes (100), (110), and (111), if the structure of alpha iron is BCC.

192. In a tetragonal lattice a = b = 2.5 AU. and c = 1.8 AU. Determine the lattice spacing between (111) planes.

193. X-ray of wavelength ‘a’ is reflected from the (111) plane of a simple cubic lattice. If the lattice constant is also ‘a’, calculate the corresponding Bragg angle.

194. The potential of a diatomic molecule as a function of a distance r between the atoms is given by V(r)= -$a/r^6 + b/r^{12}$.Find the value of the potential at equilibrium separation between atoms.

195. If phonon mean free path length in quartz crystal is 30 A and the specific heat capacity per unit volume is 4×10^3 $Jm^{-3}K^{-1}$ at 300 K, calculate lattice thermal conductivity in quartz, (assuming phonon velocity = 5×10^3 m/s).

196. Calculate the electronic specific heat of k mol of copper at 300 K. At what low temperature are the electronic and lattice specific heats of copper equal to one another? The Fermi energy of copper is 7 eV and Debye temperature for copper is 348 K.

197. The Debye temperature of carbon (diamond structure) is 1850 K. Calculate the specific heat per k mol for diamond at 20 K .

198. Show that D(E) = 3N/2E , where N is the total no of orbitals in a free electron gas with energy E.

199. Diamond (Atomic no of Carbon =12) has Young Modulus $10^{12} N/m^2$ and density of 3500 Kg/m^3. Ignoring the crystalline anisotropy and difference between longitudinal shearing module,calculate Debye Temperature.

200. Show that the wavelength of a moving electron having an energy equal to the Fermi energy at absolute zero is given by $(2\pi)/(3\pi^2)^{(-1/3)}$

201. Silver metal has FCC structure and its atomic radius is 1. 4 A. Determine its Fermi energy at 0 K.

202. There are about 5.9×10^{28} conduction electrons/m^3 in silver. Calculate its Fermi energy

203. Calculate the Fermi velocity of electrons in potassium, if its Fermi energy is given 2.1 eV .

204. The hall coefficient of certain silicon specimen is found to be -7.35×10^{-5} m^3e^{-1} from 100 K to 400 K. Determine the nature of the semiconductor. If the conductivity is 200 mho/m, calculate the density and mobility of the charge carrier.

205. The intrinsic carrier density at room temperature in Ge is 2.37×10^{19} m^3. If the electron and hole mobilities are 0.38 and 0.18 $m^2 V^{-1} s^{-1}$ respectively, calculate the resistivity.

206. Prove that the Fermi level in an intrinsic semiconductor lies in the middle of the forbidden gap if the effective masses of electrons and holes are equal.

207. The intrinsic carrier density is 1.5×10^{16} m^{-3}. If the mobility of electron and hole are 0.13 and 0.05 $m^2 V^{-1} s^{-1}$, calculate the conductivity.

208. In an intrinsic semiconductor the effective mass of the electron is 0.07 m_e and that of the hole is 0.4 m_e, where m_e is the rest mass of the electron equaling 9.1×10^{-31} Kg. Calculate the intrinsic concentration of charge carriers at 300K. Given: E_g = 0.7 eV.

209. A metal has a static conductivity of 4×10^7 mho/m. Assuming that the true charge carriers are free electrons and they are $2 \times 10^{28}/m^3$, calculate the relaxation time. ($m_e = 9.1 \times 10^{-31}$Kg, $e = 1.6 \times 10^{-19}$C) .

210. The density of Zinc is 7.13 x 10^{3} Kg/m^3 and its atomic weight is 65.4. Calculate the free energy in Zinc. Also calculate the mean energy at 0 K. The effective mass of electron is 0.85 m_e .

211. Evaluate the carrier concentration and conductivity of the intrinsic Ge at T = 300K. m_o= 9.1 x 10^{-31} Kg, E_g = 0.68 eV, μ_e = $0.38m^2$/V- Sec, μ_h = $0.18m^2$/V- Sec, K_B = 1.38 x 10^{-23} J/K,m_e=$0.55m_o$,m_h=$0.37m_o$.

212. A copper wire has a resistivity of 1.7 x 10^{-8} Ω m at room temperature of 300K. If copper is highly pure, find the resistivity at 700 ^{0} C.

213. The density of Silver is 10.5 gm/cc and its atomic weight is 107.9. Assuming that each silver atom provides on conduction electron, calculate the number of free electrons per cc. Taking conductivity of silver as 6.8 x 10^{7} mhos/m. Calculate the mobility of free electrons.

214. In an n-type semiconductor, the concentration of electron is $2x10^{22}$ m^{-3}. Its electrical conductivity is 112 mho/m, calculate the mobility of the electron.

215. A Ge sample is doped with 5 x 10^{13} Arsenic atoms per cm^3. Determine the carrier concentration of 300 K. Intrinsic concentration of Ge at 300 K is 2.5 x 10^{13} cm^{-3}.

216. Determine the percentage of ionic polarizability in the water which has the optical index of refraction and the static dielectric constant as 1.33 and 8.1 respectively.

217. Determine the percentage of ionic polarizability in the NaCl crystal which has the optical index of refraction and the static dielectric constant as 1.5 and 5.6 respectively.

218. A paramagnetic substance has 10^{28} atoms/m^3. The magnetic moment of each atom is $1.8x10^{-23}$ Am^2. Calculate the paramagnetic susceptibility at 300 K. What would be the dipole moment of a bar of this material 0.1 m long and 1 sq.cm cross section placed in a field of $8x10^4$ A/m?

219. A solid elemental dielectric with $3x10^{28}$ atoms/m^3 shows an electronic polarizability of 10^{-40} F-m^2. Assuming the internal electric field to be a Lorentz field, calculate the dielectric constant of the material.

220. *Calculate the electronic polarizability of neon. The radius of neon atom is 0.158 nm.*

221. An atom of oxygen on being polarized produces a dipole moment of $0.5x10^{-22}$ cm. If the distance of the centre of negative charge cloud from the nucleus be $4x10^{-17}$ m, calculate the polarisability of oxygen atom.(e = $1.6x10^{-19}$ C, Z of oxygen=8)

222. Derive the Claussius-Massotti relation.

223. Two parallel plates having equal and opposite charges are separated by 2 cm thickness of the dielectric slab that has dielectric constant of 1.52. I f the electric field inside is $3x10^6$ V/m. Calculate the polarisation and displacement vectors.

224. The atomic weight and density of sulphur are 32 and 2.08 gm/cm^3 respectively. The electronic polarizability of the atom is $3.28x10^{-40}$ F-m^2. If sulphur solid has cubic symmetry,what will be its relative permittivity?

225. Dielectric constant of Silicon is 12 and edge length of the conventional cubic cell of Silicon lattice is 5.43A^o. Calculate the electronic polarizability of silicon atoms.

226. When NaCl crystal is subjected to an electric field of 1000 V/m, the resulting polarisation is 4.3x10^{-8} C/m^2. Calculate the relative permittivity of NaCl.

227. Calculate polarizability of argon atom. Given, relative permittivity is 1.0024 at NTP and the gas contains 2.7x10^{25} atoms per m^3.

228. A dielectric material has ϵ_r=4.94 and n^2=2.69. Calculate the ratio between electronic and ionic polarizability of the material

229. A solid contains 5x10 ^{28} atoms/m^3 each with a polarisability of 2x10 $^{-40}$ Fm^2. Assuming that the internal field is given by Lorentz formula. Calculate the ratio of internal field to the external field.

230. The number of atoms in hydrogen gas is 9.8x10^{28} atoms per m^3. The radius of the hydrogen atom is 0.053 nm. Calculate the electronic polarizability and relative permittivity.

231. The dielectric constant of a helium gas at NTP is 1.0000684. Calculate the electron polarizability of helium atoms if the gas contains 2.7x10 ^{26} atoms/m^3 and hence calculate the radius of the helium atom.

232. A magnetic material has a magnetization of 3300 A/m and flux density of 0.0044 web/m^2. Calculate the magnetizing force and the relative permeability of the material.

233. A magnetic material has a magnetization of 2300 Am^{-1} and produces a flux density of 0.00314 Wb m^{-2}. Calculate the magnetizing force and the relative permeability of the material.

234. A paramagnetic material has a magnetic field intensity of 10^4 Am^{-1}. If the suspectibility of the material at room temperature is 3.7x10^{-5}. Calculate the magnetization and flux density in the material.

235. A magnetic field of 2000 Am^{-1} is applied to a material which has a susceptibility of 1000. Calculate the intensity of magnetisation and flux density.

236. Dy^{3+} has outer electronic configuration of 4f^9 6s^0. Calculate the magnetic susceptibility for a salt containing 1 kg mole of Dy^{3+} ions at 300K.

237. Calculate the value of magnetic susceptibility for a paramagnetic material (N=9x10^{28} m^{-3}) at 0.1 K.

238. A paramagnetic salt contains 10^{28} ions/m^3 with the magnetic moment of one bohr magneton. Calculate the paramagnetic susceptibility and the magnetization produced in a uniform magnetic field of 10^6 amp/m at 300 K.

239. The saturation magnetic induction of nickel is 0.65 Wbm^{-2} . If the density of nickel is 8906 kg m^{-3} and its atomic weight is 58.7, calculate the magnetic moment of the nickel atom in Bohr Magneton.

240. The saturation magnetic induction of nickel is 0.65 Wb/m^2. If the density of the nickel is 8906 kg/m^3 and its atomic weight is 58.7 , calculate the magnetic moment of the nickel atom.

241. A paramagnetic material has FCC structure with a cubic edge of 2.5 A^0. If the saturation value of magnetization is $1.8x10^6$ Am^{-1}, calculate the magnetization contributed per atom in bohr magneton.

242. The magnetic field strength of silicon is 1500 Am^{-1}. If the magnetic susceptibility is $(-0.3x10^{-5})$, calculate the magnetization and flux density in silicon.

243. Cr^{2+} has outer electronic configuration of $3d^4$ $4s^0$. Calculate the magnetic susceptibility for a salt containing 1 kg mole of Cr^{2+} ions at 300K.

244. Sodium metal with fcc structure has 4 atoms per unit cell. The radius of the sodium atom is 1^0A and the lattice parameter is 3.608^0A . Calculate its diamagnetic susceptibility.

245. In a magnetic material, the field strength is found to be 10^6 Am^{-1} . If the magnetic susceptibility of the material is $0.5x10^{-5}$, calculate the intensity of magnetization and flux density in the material.

246. The Curie temperature of iron is 770 ^{0}C. For iron, $\mu = 2\mu_B$ and iron is bcc with lattice parameter a = 0.286 nm. Calculate (a) the saturation magnetization (b) the Curie constant (c) Weiss field constant.

247. A typical magnetic field achievable with an electromagnet with iron core is about 1 Tesla. Compare the magnetic interaction energy,$\mu_B B$ of an electron spin magnetic dipole moment with $k_B T$ at room temperature(300 K) and show that at this temperature the approximation $k_B T/\mu_B B >> 1$ is valid.

248. The critical temperature Tc, for mercury with isotopic mass 199.5 is 4.185 K. Calculate the critical temperature when its isotopic mass changes to 203.4.

249. The critical temperature of a superconductor at zero magnetic field is Tc. Determine the temperature at which the critical field becomes half of its value at 0 K

250. The critical fields at 6 K and 8 K for a NbTi alloy are 7.616 and 4.284 MA/m respectively. Determine the transition temperature and the critical field at 0 K.

251. A superconducting material has a transition temperature of 3.7 K at zero magnetic field and a critical field of 3x105 A/m at 0 K. Find the critical field at 2 K.

252. Prove that the susceptibility of superconductor is -1 and relative permeability is zero.

253. Calculate the critical current density of 1 mm diameter wire of lead at a) 4.2 K and b)7 K. Given TC for lead is 7.18 K and HO for lead is 6.5x104 ampere/m.

254. The critical magnetic fields of a superconductor at temperatures 4K and 8K are 11mA/m and 5.5mA/m respectively. Find the transition temperature.

255. A superconducting lead has a critical temperature of 7.26K at zero magnetic field and a critical field of 8×105 A/m at 0K. Find the critical field at 5 K

256. A fluxoid is approximately equal to 2x107 gauss-cm2. A type II superconductor is placed in a small magnetic field, which is then slowly increased till the field starts penetrating the superconductor. The strength of the field at this point is(2/pi) x105 gauss a) Calculate the penetration depth of this superconductor b) The applied field is further increased till superconductivity is completely destroyed. The strength of the field is now(8/pi) x105 gauss. Calculate the correlation length (k) .

257. Lead in the superconducting state has the critical temperature of 6.2 K at zero magnetic field and a critical field of 0.064 MA/m at 0 K. Determine the critical field at 4 K.

258. In lead (Pb) the binding energy of cooper pair is 10 meV. Calculate a) critical temperature of Pb. (hint: B. E=Eg) b) Maximum wavelength of photons required to break the cooper pair

259. Define London Penetration depth. Calculate the value of the London Penetration depth at 0 K for lead whose density is 11.3x 10 3 kg/m^3 and the atomic weight is 207.19. (Tc= 7.22K). Calculate the increase in london penetration depth at 3.61K from 0 K.

260. What is London Penetration depth? The London Penetration depths for Pb at 3 K and 7.1 K are respectively 39.6 nm and 173 nm. Calculate its transition temperature as well as Penetration depth at 0K.

261. The penetration depth of lead are 396 A˚ and 1730 A˚ at 3 K and 7.1 K respectively. Calculate the critical temperature of lead.

262. Derive the expression for current density in d.c Josephson effect.

263. Find the voltage required to produce 483.6 MHz through the Josephson junction.

264. Determine the frequency of the electromagnetic waves radiated by a Josephson junction across which a dc voltage of 0.5 mV is applied.

265. Derive the expression for current density in a.c Josephson effect.