BE Metallurgical & Material Engineering Third Year Second Semester Examination 2018

Ref No. : Ex/Met/T/325/2018

Physics of Metals

Time : Three hours | **(Answer any 5 questions)** | Full Marks : 100

1. (a) Find the solution of a free particle in a rigid box in one dimension. Show that confinement gives rise to quantization. **10+4**
   (b) Assuming the solution for free electrons obeying the periodic boundary condition find the expression for momentum of free electrons. **6**

2. (a) Define Fermi energy. Find an expression for Fermi energy of free electrons **2+10**
   (b) Find an average energy of free electrons in the ground state **8**

3. (a) Find the origin of band gaps in solids **15**
   (b) Draw and explain the density of states curve for the first Brillouin zone **5**

4 (a) Find an expression for the conductivity of metals **10**
   (b) Show for metal only electrons lying near the Fermi energy can take part into conduction. **5**
   (c) Solids having half filled zones behave like a conductor; explain. **5**

5 (a) Derive an expression for effective mass of electrons and hence explain the contribution of electrons to conduction when the electrons approach the zone boundary. **10+4**
   (b) Show that β-phase in cubic alloy system arises at an electron concentration of 1.5. **6**

6 (a) Show that a current loop of area A and carrying current I in anticlockwise direction is equivalent to a magnetic dipole moment ($\overrightarrow{\mu_m}$) and is given by, **10**
   $\overrightarrow{\mu_m} = IA\hat{n}$
   Where $\hat{n}$ is a unit vector pointing normally outward to the plane of current loop.
   (b) Show that an electron moving in a circular Bohr orbit produce a magnetic moment given by **10**
   $\overrightarrow{\mu_m} = -\frac{e}{2m}\overrightarrow{M_a}$
   Where the symbols have usual meanings.

7 (a) Find an expression for the magnetization of a paramagnetic substance. Using this expression explain the Curie-Weiss Law and spontaneous magnetization of a ferromagnetic substance. **10+5+5**

8 (a) Define pole, glide plane and Screw axis **2+2+2**
   (b) Explain that the five -fold symmetry for crystal is excluded **10**
   (c) Explain how you get the stereographic projection of pole **4**