Ref. No.: Ex/Met/T/325/2019

B.E. METALLURGICAL AND MATERIAL ENGINEERING THIRD YEAR SECOND SEMESTER EXAM-2019

PHYSICS OF METALS

Time: Three Hours | Full Marks: 100

(Answer any five questions)

1.	(a) State the fundamental postulates of quantum mechanics. Using the operator formalism find the expression for one dimensional time-dependent Schrodinger wave equation. Find the expression for the time independent Schrodinger wave equation. (b) Find the average position of a free particle in a one-dimensional rigid box.	3+6+5 6
2.	(a) Define Fermi energy. Find an expression for the Fermi energy of free-electrons. (b) Find the average energy of electrons in the ground state.	2+10 8
3.	(a) Find the origin of band gaps in solids. (b) Find the expression for the density of states for free electrons in solids.	14 6
4.	(a) Find the expression for the effective mass of electrons. (b) State and explain the classification of solids based on electrical conductivity from the point of view of zone theory.	10 10
5.	(a) Using the zone theory, explain qualitatively that the stability of different alloy phases is determined by electron concentration. Show that the stability limit of α-phase in the cubic alloy system is up to an electron concentration of about 1.4. (b) Discuss the shortcomings of quantum mechanical free electron theory.	5+10 5
6.	(a) Discuss the classification of magnetic materials. (b) Show that a current loop of area A and carrying current I produces a magnetic dipole moment of magnitude μ_m ,given by, $\mu_m = IA$	10 10
7.	(a) Using the theory of paramagnetic spin system find an expression for Curie constant. (b) Discuss the characteristic features of ferromagnetic materials.	12 8
8.	(a) Define translational symmetry, plane of symmetry, and rotational symmetry (b) Theoretically explain the existence of spontaneous magnetization in ferromagnetic materials.	3+2+3 12