September 2022

B.Tech. (EIC) Reappear 2nd Sem.

Physics II (HAS - 102)

Time: 3 Hours

Max. Marks:60

Instructions : 1. *It is compulsory to answer all the questions (2 marks each) of Part -A in short.*

2. *Answer any four questions from Part -B in detail.*

3. *Different sub-parts of a question are to be attempted adjacent to each other.*

PART -A

Q1 (a) The Fermi energy of silver at 0K is 5 eV. Determine the mean energy of electron in silver at 0K. (2)

(b) In a crystal, a lattice plane cuts intercepts a, 2b and 3c along the three axes, where a, b and c are the primitive axes of the unit cell. Determine the Miller indices of the given plane. (2)

(c) Write short note on Quantum dots. (2)

(d) Show that the probability of occupancy of fermi level is 50% at all temperatures. (2)

(e) Show that the atomic packing factor for the FCC crystal structure is 0.74. (2)

(f) Draw Miller planes (211) and (011) in separate unit cells. (2)

(g) What are Extrinsic semiconductors? (2)

(h) Assuming that there are 5×10^{25} atom/m^3 in copper, find the Hall coefficient. (2)

(i) Differentiate between group velocity and phase velocity. (2)

(j) Write a short note on ferromagnetic domains. (2)

PART -B

Q2 (a) How do you classify a material as dia, para or ferromagnetic? Discuss classical theory of paramagnetism in detail. (6)

(b) Explain why copper crystal is diamagnetic, even though the copper atom has an outer electron configuration of $3d^{10}4s^1$. The diamagnetic susceptibility of copper is -0.5×10^{-5}. For an applied field of 100 kA m^{-1}, find the induction B and the magnetization M. (4)

Q3 (a) How do you explain the origin of energy bands in solids? Explain with the support of a simple model. (4)

(b) Define Hall-effect and derive expressions for Hall coefficient, Hall mobility and Hall angle. Mention any four applications of Hall-effect. (6)

Q4 (a) What is quantum mechanical one-dimensional box? Write Schrodinger equation for it and obtain eigen functions and eigen values. (6)

(b) The fraction of vacancy sites in a metal is 1×10^{-10} at 500°C. What will be the fraction of vacancy sites at double the temperature? (4)

Q5 (a) What does the word 'Hadron' mean in particle physics? Mention all the important characteristics of Hadrons. (5)

(b) Discuss the various 'point defects' in solids. (5)

Q6 (a) What is free-electron theory of metals? Derive the expression for conductivity of metals on the basis of Drude-Lorentz theory (5)

(b) Discuss briefly any one experimental method for crystal structure determination by X-ray diffraction. (5)

Q7 (a) Nanosystems are fabricated/synthesized by means of different techniques. Explain any two of them in detail. (6)

(b) An X-ray tube is operated at 25 kV. Calculate the minimum wavelength of X-rays emitted from it. (4)