24019

B.Tech. 2nd Semester F Scheme

Examination, May–2014

PHYSICS-II

Paper–PHY-101-F

Time allowed : 3 hours] *[Maximum marks : 100*

Note : Question No. 1 is compulsory. *Students have to attempt **five** questions in total selecting at least **one** question from each section. Each question carries equal marks (20 marks).*

1. (i) Show the relation; $d_{100} : d_{110} : d_{111} = 1/\sqrt{2} : 1/2\sqrt{3}$ for body centered cubic lattice. 2

(ii) Find out angle between the directions [101] and [111] in a cubic lattice by geometrical method. 2

(iii) Write the Miller indices for planes in the given set of intercepts (a, b/2, c). 2

(iv) Find the de-Broglie wavelength of an electron with a velocity of 10^7 m/s. 2

(v) Write the expectation value of energy and momentum operator. 2

(vi) Give the definition of Relaxation time. 2

(vii) Give the definition of Ehrenfest's theorem. 2

(viii) What do you mean by concept of quantum size effect ? 2

(ix) What do you understand by the term concept of hole ? 2

(x) Define the term Bloch wall separation. 2

Section–A

2. Explain clearly the concept of Miller indices. Show that the spacing **d** of plane (h k l) in a simple cubic lattice of side **a** is $d = \frac{a}{(h^2 + k^2 + l^2)^{1/2}}$. 20

3. Calculate the expectation value of p and p^2 for the normalized wave function $\psi(x) = \left(\frac{2}{L}\right)^{1/2} \sin\left(\frac{\pi x}{L}\right)$ in region $0 < x < L$ and $\psi(x) = 0$ for $x > L$ and $x < 0$. Where, p is the momentum of the particle. 20

Section–B

4. What is the condition for thermionic emission ? Derive Richardson's equation and write its importance. 20

5. (a) The resistivity of Aluminum at room temperature is 2.60×10^{-8} ohm-m. Calculate :

   (i) drift velocity at a electric field of 1000 V/m

   (ii) mobility

   (iii) relaxation time and

   (iv) mean free path, on the basis of classical theory. 10

   (b) What are Quantum dots (QD) write one of the applications of QD ? 10

Section–C

6. (a) A silicon (si) sample is doped with $10^{16}/cm^3$ boron atoms, and a certain number of shallow donors. The Fermi level is 0.36 eV above E_i at 300 K. What is donor concentration N_d ? 10

   (b) Describe the working and use of photovoltaic cells. Sketch its characteristic curves. 10

7. Define Hall-Effect and derive expressions for Hall coefficient, Hall mobility and Hall angle. Discuss experimental determination of hall coefficient. Mention any four applications of Hall-Effect and explain determination of flux density using Hall's apparatus. 20

Section–D

8. What do you mean by ferromagnetic domains ? Give an account of Weiss theory of ferromagnetism and show the plot of Langevin's function, spontaneous magnetization exists below the Curie temperature and vanishes above the Curie temperature. 20

9. What are paramagnetic, diamagnetic and ferromagnetic materials ? Give examples. Derive an expression for magnetic susceptibility of paramagnetic material using Langevin's theory. 20