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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