SPRING END SEMESTER EXAMINATION-2014

2nd Semester B.Tech/B.Tech Dual

PHYSICS-II PH-201

(Regular-2013 Admitted Batch)

Full Marks: 60 **Time: 3 Hours**

Answer any SIX questions including Question No.1 which is compulsory.
The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable and all parts of a question should be answered at one place only.

1. a) Draw the black body radiation spectrum. How does it change with rise in temperature? [2 × 10

   b) A radio transmitter operates at a frequency of 880 Hz and power 10 kW. How many photons does it emit per second?

   c) Show that in a non-dispersive medium group velocity is equal to phase velocity.

   d) Write down the differences between matter waves and electromagnetic waves.

   e) Monoenergetic particles of energy E are incident on a potential step of height E/2. Find the reflection coefficient and transmission coefficient.

   f) Explain unit cell and primitive unit cell with appropriate diagrams.

   g) The interplanar spacing of (110) plane is 2.2 Å for a simple cubic crystal. Calculate the atomic radius.

h) An intrinsic semiconductor is doped with aluminum. Show the position of the Fermi level in the energy band diagram.

i) Write down Bragg's law of diffraction in crystallography.

j) State and explain Meissner's effect.

2. a) What is Compton effect? Derive the expression for Compton shift and hence find the frequency of scattered photon in terms of frequency of incident radiation and scattering angle. [6

b) Light of frequency greater than the threshold frequency is incident on a photocell but still no photo current is observed. What can be the possible reasons for this? [2

3. a) What do you mean by a free particle in quantum physics? Establish Schrodinger's time independent equation for a free particle in one dimension. [6

b) Plot the variation of uncertainty in momentum with uncertainty in position according to Heisenberg's uncertainty principle. [2

4. a) Write down Schrodinger's equation for a particle confined in a one dimensional potential box of infinite height. Solve it to obtain eigen functions and show that eigen values are discrete. [6

b) Calculate the probability of finding a particle trapped in a one dimensional box of length L in a region from 0 .45L to 0.55L for the ground state. [2

5. a) With suitable diagrams find out the effective number of atoms per unit cell and the atomic radii for *SC, FCC and BCC* lattice structure. Hence calculate the packing fraction for each of them. [6

b) Write down any four applications of superconductors. [2

6. a) Derive the expression for the electron concentration in conduction band of an intrinsic semiconductor and show that in intrinsic semiconductor Fermi level lies exactly at the middle of the forbidden energy gap. [6

b) The unit cell dimension '*a*' of NaCl lattice is 5.63 Å. If X-rays of wavelength 1.1 Å fall on a family of planes with a separation of $a/\sqrt{5}$, how many orders of diffraction are observable? [2

7. a) Based on the band theory of solids, distinguish between conductors, semiconductors and insulators. [4

b) What do you mean by normalization of a wave function? Normalize the wave function $\psi = \cos^2 x$ in the region $-\pi/2$ to $\pi/2$. [4

8. Write short notes on [4 × 2

a) Quantum mechanical tunneling

b) Type-I and Type-II superconductors

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