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Special/Back Examinations, 2012

PHYSICS-II

Full Marks: 70

Time: 3 Hours

Answer six questions including question No.1 which is compulsory
Figures in the right hand margin indicate marks

Q1. Answer the followings

2x10

- a) How nuclear radiation is used in automobile plants?
- b) 10kV electrons are passed through a thin film of a metal for which the atomic spacing is 5.5×10^{-11} m. What is the angle of deviation of the first order diffraction maximum?
- c) What are the similarities and dissimilarities between energy level band diagram of germanium and carbon ?
- d) Can a beam of neutrons be used to study crystal structure ? Explain why or why not?
- e) Explain 1-2-3 superconductors.
- f) Define critical magnetic field. How does the critical magnetic field vary with temperature in type-II superconductors.
- g) Distinguish between monomode and multimode optical fiber.
- h) Distinguish between stimulated absorption and stimulated emission.
- i) Write two industrial applications of laser.
- j) Sodium crystallizes in bcc structure. If the radius of the sodium atom is 1.732 nm, compute the spacing between (111) planes.

Q2.

- a) Explain the principle and working of Van de Graaff accelerator? What is the function of collection comb used in Van de Graaff accelerator? 4
- b) Describe the construction and working of a betatron by neat diagram. Derive an expression for Betatron condition. 6

Q3.

- a) Deuterons in a cyclotron describe a circle of radius 30 cm just before emerging from dees. The frequency of the applied alternating voltage is 10 MHz. Neglecting relativistic effects find the energy and speed of a deuteron on emergence. 4
- b) Prove that the BCC and FCC lattices are reciprocal lattices of one another. 4
- c) Draw the crystal directions [213] and crystal plane (213) in the cubic system. 2

Q4.

- a) Derive Laue's formula from the diffraction theory. 4
- b) Define atomic form factor .What does it represent? Write an expression for it? 3
- c) The critical temperature for Hg is 54.185 K and isotopic mass 199.5 .If the isotopic mass changes to 203.4 . Calculate its critical temperature. 3

Q5.

- a) Describe Kronig - Penney model of solids . Explain how Kronig –Penney model predicts presence of allowed and forbidden bands with change in the strength of periodic potential. Prove that the width of forbidden energy bands decreases with increasing energy value. 6
- b) Discuss a method of investigating the structure of a single crystal using X-rays. 4

Q6.

- a) Derive the London equation and explain the terms coherence length and London's penetration depth. 6
- b) The penetration depth λ of mercury at 3.5 K is about 75nm. Estimate the values of λ as T tends to 0 and $T_c= 4.12$ K 4



Q7.

- a) Explain the construction and working of semiconductor laser with neat energy level diagram. 6
- b) Write the advantages of four level laser over three level maser. 4

Q8.

- a) In a step index optical fiber the refractive index of core is 1.55 and the numerical aperture is 0.248. Calculate the refractive index of clad . 3
- b) Explain with the block diagram the fibers communication system. 4
- c) What are the advantages of Fiber optic communication system over the traditional coaxial or copper cable communication? 3