Code :R7100203

R7

B.Tech I Year (R07) Supplementary Examinations, December 2010
APPLIED PHYSICS
(Electrical & Electronics Engineering, Electronics & Communication Engineering, Computer Science & Engineering, Electronics & Instrumentation Engineering, Biomedical Engineering, Information Technology, Electronics & Control Engineering, Electronics & Computer Engineering, Computer Science & Systems Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE questions
All questions carry equal marks

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1. (a) Define
   i. lattice constant
   ii. packing fraction and
   iii. coordination number.
   (b) Compare the unit cell properties of SC, BCC and FCC structures.

2. (a) What are Miller indices? Draw (111) and (110) planes in a cubic lattice.
   (b) Explain Bragg's law of X-ray diffraction.
   (c) The Bragg's angle for reflection from the (111) plane in a FCC crystal is 19.2^o for an X-ray wavelength of 1.54 A.U. Compute the cube edge of the unit cell.

3. (a) Show that the wavelength of an electron accelerated by a potential difference 'V' volts, is $\lambda = 1.227 \times 10^{-10}/\sqrt{V}$ m for non-relativistic case.
   (b) Describe an experiment to establish the wave nature of electrons.
   (c) Explain the difference between a matter wave and an electromagnetic wave.

4. (a) What are the salient features of the "free electron gas" model? Obtain Ohm's law based on it.
   (b) Explain the concept of "effective mass".

5. (a) What is local field? Explain. Show that the local electrical field E_{loc} is given by$E_{loc} = E\left(\frac{\varepsilon_r+2}{3}\right)$ where E is the applied electric field.
   (b) An air-filled capacitor has a capacitance of 1.3 pf. The separation of the plates is halved and a dielectric is inserted between them. The new capacitance is 3.9 pf. Find the dielectric constant of the dielectric.

6. (a) Explain the effect of temperature and dopent on the Fermi level in a semiconductor.
   (b) i. Find the conductivity of intrinsic silicon at 300 K. It is given that n_i at 300 K in silicon is $1.5 \times 10^{16}/m^3$ and the mobilities of electrons and holes in silicon are 0.13 m^2/V-s and 0.05 m^2/V-s respectively.
   ii. If donor type impurity is added to the extent of one impurity atom in 10^8 silicon atoms, find the conductivity.
   iii. If acceptor type impurity is added to the extent of one impurity atom in 10^8 silicon atoms, find the conductivity.

7. (a) Explain the following:
   i. Life time of an energy level.
   ii. Optical pumping processes.
   iii. Metastable states.
   (b) Distinguish between spontaneous and stimulated emission processes of light.
   (c) Discuss briefly the different methods of producing laser light.

8. (a) Distinguish between light propagation in
   i. step index and
   ii. graded index optical fibres.
   (b) Discuss the various advantages of communication with optical fibres over the conventional coaxial cables.
   (c) Calculate the refractive indices of core and cladding of an optical fibre with a numerical aperture of 0.33 and their fractional difference of refractive indices being 0.02.

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