B.E.(with Credits)-Regular-Semester 2012- All Branches Sem I & II

# 110 - Group-A : Applied Physics

P. Pages : 3 **GUG/W/16/3666**

Time : Three Hours * 3 9 3 7 * Max. Marks : 80

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Notes : 1. All questions carry equal marks.
2. Due credit will be given to neatness and adequate dimensions.
3. Assume suitable data wherever necessary.
4. Illustrate your answers wherever necessary with the help of neat sketches.
5. Use of non – programmable / scientific calculator is permitted.

LIST OF CONSTANTS:

1. Planck's constant (h) = $6.62 \times 10^{-34}$ J-s.
2. Velo. of light (c) = $3 \times 10^{8}$ m/s
3. Boltzmann constant (k) = $1.38 \times 10^{-23}$ J/ok
4. Charge of electron (e) = $1.6 \times 10^{-19}$ coulomb
5. Mass of electron (m) = $9.1 \times 10^{-31}$ kg

**1.** a) Briefly explain Davisson & Germer's electron diffraction experiment for the determination of electron wavelength. **6**

b) Explain Heisenberg uncertainty principle. Using following data, show that the electron cannot exist in the nucleus. **6**
Data: The radius of the nucleus is approximately $10^{-4}$ m. The maximum kinetic energy of electron in an atom is 4 MeV.

c) How much should be the voltage of x – ray tube so that the electron emitted from cathode may produce x – rays of wavelength 1 $A^{o}$ ? **4**

**OR**

**2.** a) From the concept of Schrodinger wave equation, discuss the energy levels of a particle enclosed in one – dimensional box of infinite height and show that they are discrete. **6**

b) State the law of conservation principles for momentums appeared in the phenomenon of Compton scattering. Hence prove that the de Broglie wavelength of recoil electron is given by $\lambda = \frac{C}{\sqrt{\nu^2 + \nu'^2}}$ if the scattered photon is deserved to travel at $90^{o}$ to the incident beam. (the letters used above are having their usual meanings). **6**

c) Find the de Broglie wavelength associated with an electron moving with velocity of 0.3 times of velocity of light. **4**

**3.** a) Draw energy band diagrams of P – N junction diode in **6**
i) Forward biased
ii) Reverse biased

b) Deduce the relation for junction diode, the height of potential barrier, **6**

$$V_0 = \left(\frac{KT}{e}\right) \log\left(\frac{N_d \cdot N_a}{n_i^2}\right)$$ where letters have their usual meanings.

c) Find the fraction of electrons in the valance band of intrinsic germanium which can be thermally excited across the forbidden energy gap of 0.7 ev into the conduction band at 300 ºK. **4**

**OR**

**4.** a) Define & explain Hall effect in semiconductors obtain the relation for Hall voltage and Hall angle interms of Hall coefficient. **6**

b) State Fermi – Dirac probability relation, show that at all temperature (T > OK) and at $E = \frac{E}{F}$ probability of occupancy of fermi level is 50% Represent it graphically. **6**

c) Calculate the value of Hall angle $\theta_H$ for a semiconductor on the basis of the following data. **4**

Hall coefficient ($R_H$) = 3.66 x $10^{-4}$ $m^3/c$
Resistivity ( $\rho$ ) = 8.3 x $10^{-3}$ $ohm^{-m}$
magnetic flux density (B) = 0.5 $Wb/m^2$

**5.** a) Define and explain the terms: **6**

i) Unit cell
ii) Coordination Number
iii) Effective number of atoms per unit cell

b) Find and compare atomic radius, packing fraction and voids for SC, BCC and fcc unit cell lattice. **6**

c) Calculate the wavelength of X – rays by assuming first order diffraction, if (111) plane diffracts with (32.1)º by the atoms of solid of fcc structure with its atomic radius 1.44 Aº. **4**

**OR**

**6.** a) What are Miller Indices? Draw planes on cubic unit cell i) 200 ii) 210 iii) 112 iv) 101. **6**

b) Deduce the relation between an interplanar distance (d) and Miller indices of the planes for cubic crystal. **5**

c) Determine the atomic mass of iron of BCC structure whose lattice constant at room temperature is 2.87 Aº and the density be 7870 $Kg/m^3$ (Given Avogadro's Number $N_A$ = 6.023 x $10^{26}$ /K - mol) **5**

**7.** a) Describe various mechanisms of attenuation in optical fibre. **6**

b) Find an expression for the acceptance angle for an optical fibre. Show how it is related to numerical aperture. **6**

c) A fibre cable has an acceptance angle of 30º and a core index of refraction of 1.4. Calculate the cladding index of refraction. **4**

**OR**

**8.** a) Define and explain : **6**
- i) Population Inversion
- ii) Resonant cavity
- iii) Stimulation emission

b) Explain principle working of Ruby Laser with the help of neat labelled energy band diagram. **6**

c) Compute the coherence length of yellow light with 5893 Aº in $10^{-12}$ second pulse duration find also spectral half width. **4**

**9.** a) Draw schematic block diagram of CRT & describe the role of i) electron gun ii) Deflection system iii) fluorescent screen iv) Aquadag coating. **6**

b) Discuss the motion of charged particle projected into uniform electric field at an acute angle with field direction and hence obtain the formula for range, time of flight and maximum height attained by a particle. **6**

c) In a Bainbridge mass spectrograph, singly ionised atom of $N_e^{20}$ passes into deflection chamber with velocity of $10^5$ m/s. If they are deflected by a magnetic field of fluxdensity of $8 \times 10^{-2}$ wb/m$^2$. Calculate the radius of the path of singly ionised atom (1 amu = $1.67 \times 10^{-27}$ kg). **4**

**OR**

**10.** a) Derive a relation for fringe width in case of wedge shaped film. Show that the distance of separation between two consecutive dark or bright band is constant. **6**

b) What is antireflection coating? Obtain the condition for minimum thickness of such coating. **6**

c) Fringes of equal thickness are observed in a thin glass wedge of refractive index 1.52. The fringe spacing is 0.1 mm and wavelength of light is 5893 Aº. Calculate the angle of the wedge. **4**

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