B.E. I & II First Year First/Second Semester Old (C.B.S. Pattern)

110 - Applied Physics

P. Pages : 3 **GUG/W/18/1451**

Time : Three Hours * 1 1 4 9 * Max. Marks : 80

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:

i) Planck's constant, $h = 6.632 \times 10^{-34}$ J.S.

ii) Velocity of Light, $c = 3 \times 10^{8}$ m/s

iii) Charge on electron, $e = 1.6 \times 10^{-19}$ C

iv) Mass of electron, $m_e = 9.11 \times 10^{-31}$ kg

v) Boltzmann Constant, $k = 1.38 \times 10^{-23}$ J/K, $= 8.61 \times 10^{-5}$ eV/K

vi) Avogadro's Number, $N_A = 6.023 \times 10^{26}$ atoms/Kmol

vii) Charge of α particle $= 3.2 \times 10^{-19}$ C

viii) Mass of α Particle $= 6.68 \times 10^{-27}$ kg

1. a) Explain the concept of a wave packet. How does this concept leads to Heisenberg's uncertainty principle? Hence state Heisenberg uncertainty principle. **6**

b) State Compton effect. Explain why the Compton effect is not observed in case of heavier element and visible light. **6**

c) An electron is confined to move between two rigid walls separated by 1nm. Find de-Broglie wavelength representing the first two allowed energy states of the electron and the corresponding energies. **4**

OR

2. a) What is wave function Ψ ? What mathematical conditions the wave function must satisfy to be an acceptable wave function? **5**

b) Show that the energy of an electron confined in a 1-D potential well of length 'ℓ' and infinite depth is quantized. **6**

c) A beam of gamma radiation having photon energy 510 keV is incident on a foil of aluminum. Calculate the wavelength of radiation at 90°. **5**

3. a) What is fermi function? Draw a graph showing its variation with energy at different temperatures and discuss it. **6**

b) Draw a neat, Well -labelled energy band diagram for N-P-N transistor, showing the currents when. **6**
i) Unbiased ii) Under Proper bias

c) Find the temperature at which there is 1% probability that a state with energy 2eV is occupied. Given that fermi energy is 1.5 eV. **4**

OR

4.	a)	What is Hall effect? Derive an expression for Hall coefficient. What is the effect of temperature on Hall coefficients for semiconductor.	**2+4+1**
	b)	In a P- N junction what are diffusion and drift currents. Hence explain the existence of depletion layer.	**2+3**
	c)	Estimate the fraction of electrons in conduction band at Room temp. in Germanium with Eg= 0.72 eV.	**4**
5.	a)	Show that SC structure possesses minimum percentage of packing density and maximum percentage of VOID space among the three cubic crystal structure.	**6**
	b)	What do you understand by miller indices of a crystal plane? Obtain an expression for interplanar spacing in cubic crystal.	**6**
	c)	Find the interplanar spacing in case of copper for planes (212). The first order Bragg's reflection take place at 20º with planes (212). Find the wavelength of incident X-rays if a= 3.615Aº.	**4**

OR

6.	a)	Derive relation between atomic radius and lattice constant 'a' in case of SC, BCC and FCC lattice.	**6**
	b)	State and deduce Bragg's condition for observing X-ray diffraction from a crystal and state its applications.	**1+4+2**
	c)	A substance with FCC lattice has density 6250 kg/m^3 and molecular weight 60.2. Calculate the lattice constant 'a'.	**3**
7.	a)	What do you understand by antireflection coating? Deduce an expression for amplitude condition and phase condition.	**2+2+3**
	b)	A wedge shaped film is illuminated by monochromatic light. Obtain an expression for fringe width of interference pattern formed.	**5**
	c)	A soap bubble seen in while light being incident normally, shows a particularly strong reflection for first order of red wavelength 6300Aº. If the refractive index of soapy water is 1.38. Find out the thickness of the film.	**4**

OR

8.	a)	Draw the block diagram of CRO. Explain the use of time base circuit in CRO.	**2+4**
	b)	Explain the principle and working of Bainbridge mass spectrograph. What are its uses?	**5+1**
	c)	An electron is accelerated through a potential difference of 5 kV and enter uniform magnetic field of 0.02 Wb/m^2 acting normal to the direction of electron motion. Determine radius of the path.	**4**

9. a) Explain what is step index, graded index, monomode and multimode fiber. Draw relevant sketches. **6**

b) Explain the working of optical fiber as liquid level detector. **3**

c) Explain total internal reflection phenomenon in detail with necessary diagram. **3**

d) For a step index fiber with a core of R.I. 1.54 and cladding R.I. 1.50. Calculate the following when fiber is kept in water **4**

i) Fractional R.I. change

ii) Numerical Aperture

iii) V- number

iv) Number of modes

The diameter of the fiber is 15μm. It is operated at a wavelength of 1.5μm.

OR

10. a) Explain construction and working of Ruby laser with neat energy level diagram. **6**

b) Explain in Brief:

i) Stimulated emission of radiation. **2**

ii) 4- level laser system. **2**

iii) Population inversion. **2**

c) A laser medium at thermal equilibrium temperature 300 K has two energy levels with a wavelength separation of 1μm. Find the ratio of population densities of upper level to lower level. **4**

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