B.E. First Semester All Branches (C.B.S.) / B.E. First Semester (Fire Engineering)

Engineering Physics

P. Pages : 2 **NKT/KS/17/7197**

Time : Two Hours * 0 2 3 1 * Max. Marks : 40

Notes :
1. All questions carry marks as indicated.
2. Solve Question 1 OR Questions No. 2.
3. Solve Question 3 OR Questions No. 4.
4. Solve Question 5 OR Questions No. 6.
5. Solve Question 7 OR Questions No. 8.
6. Assume suitable data whenever necessary.
7. Use of non programmable calculator is permitted.

List of constants :

1. Planck's constant $'h' = 6.63 \times 10^{-34}\ JS$
2. Velocity of light $'C' = 3 \times 10^{8}\ m/s$
3. Charge on electron $'e' = 1.602 \times 10^{-19}\ C$
4. Mass of electron $'m' = 9.11 \times 10^{-31}\ kg$
5. Avogadro's constant $'N_A' = 6.023 \times 10^{26}\ \frac{atoms}{k\ mole}$
6. Boltzman's constant $'K' = 1.380 \times 10^{-23}\ JK^{-1}$

1. a) What is Compton effect? Why classical theory failed to explain it? **2+2**

b) In case of high atomic no. scatterer element intensity of unmodified wavelength is higher than that of modified wavelength. Explain. **3**

c) X-rays of initial wavelength $0.5 \times 10^{-10}\ m$ undergo Compton Scattering. Find the scattering angle at which wavelength of scattered X-rays will be greater than that of incident wavelength by one percent? **3**

OR

2. a) What is de-Broglie hypothesis? Obtain an expression for wavelength associated with an electron accelerated through a potential difference of 'V' volts. **4**

b) Show how the Bohr's quantization condition of angular momentum follows the concept of matter waves. **3**

c) Calculate de-Broglie wavelength of the orbital electron of Hydrogen atom. (Given that energy of electron is 13.6 eV) **3**

3. a) Derive an expression for wave function of an electron confined to move in an infinite potential well of width 'L'. **5**

b) What is a wave packet? **2**

c) Find the lowest energy of an electron in one dimensional potential well of width $2\,\text{A}^{o}$. Express the result in electron volts. **3**

4. a) Discuss a thought experiment of electron diffraction to arrive at Heisenberg uncertainty principle with suitable diagram. **4**

b) Define phase velocity and group velocity. **2**

c) Calculate uncertainty in location of an electron and a ball of mass 1 kg if their velocities are $10^5\,\text{m/s}$ and 10 m/s respectively. **4**

5. a) Derive expression for atomic radius and atomic packing fraction (A.P.F.) for BCC and FCC structures and show that percentage void space is more in BCC compared to FCC structure. **6**

b) Molybdenum has BCC structure. Its density is $10.2\times10^3\,\text{kg/m}^3$ and its atomic wt. is 95.94. Determine radius of Molybdenum atom. **4**

6. a) What are Miller Indices? Draw the crystal planes in simple cubic structure having Miller Indices (i) (102) and (ii) (0 10). **3**

b) State and derive Bragg's Law of X-ray diffraction. **4**

c) The d_{110} interplaner spacing in a BCC metal vanadium is $2.15\ \text{A}^{o}$. Find its lattice constant (a). **3**

7. a) Explain classification of solids on the basis of energy band diagrams. **3**

b) Draw energy band diagrams for the following : **2+2**
i) PN Junction in Reverse Bias
ii) NPN Transistor (unbiased)

c) Find V_0 across a silicon junction at room temperature, if p-region has 10^{21} acceptor atoms/m^3 and N-region has $10^{22}\,\text{atoms/m}^3$. **3**

8. a) What is Hall effect? Obtain an expression for Hall voltage if p-type semiconductor material is used. **2+3**

b) What is meant by depletion region? **2**

c) Determine the probability of an electron thermally excited into the conduction band in Germanium at 27ºC, if the energy gap is 0.72 eV. **3**

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