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

Engineering Physics

P. Pages : 2 **NIR/KW/18/3282/3937**

Time : Two Hours * 1938 * 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. Illustrate your answers whenever necessary with the help of neat sketches.
8. Use of non programmable calculator is permitted.

List of constants :

Planck's Constant $h = 6.63 \times 10^{-34}$ J.Sec

Velocity of light $c = 3 \times 10^{8}$ m / sec

Charge of electron $e = 1.602 \times 10^{-19}$ C

Mass of electron $m_0 = 9.11 \times 10^{-31}$ kg

Avogaro's No. $N_A = 6.023 \times 10^{26}$ atoms / kmole

Boltzmann constant $k = 1.38 \times 10^{-23}$ J / K

1. a) State de Broglie hypothesis. Describe an experiment which proves the validity of de Broglie hypothesis regarding wave nature of matter. **1+4**

b) In Compton effect, what will happen when X-ray photon collides with tightly bound electron ? Explain At which scattering angle, Compton shift is maximum and minimum ? **2+1**

c) X-rays of wavelength 1 Aº are scattered from a carbon block. The scattered radiation is viewed at right angles to the incident radiation. Calculate the observed Compton shift. **2**

OR

2. a) Using de Broglie Hypothesis, obtain Bohr's Quantization Condition of angular momentum of an electron revolving in n^{th} orbit of the atom. **3**

b) Write equations of energy and momentum conservation during collision of an X-Ray Photon with a free electron in Compton effect. **3**

c) Bullet of mass 50 gm and an electron both travel with velocity of 1100 m/sec. What wavelengths can be associated with them ? Why the wave nature of bullet is not revealed through the effect ? **3+1**

3. a) State Heisenberg's uncertainty principle. Arrive at Heisenberg's Uncertainty Principle with the help of thought experiment. **4**

b) What do you mean by phase velocity and group velocity ? Obtain relation between phase velocity and group velocity. **3**

c) An electron and a 150 gm base ball are travelling at a velocity of 220 m/sec measured to an accuracy of 0.005%. Calculate and compare uncertainty in position of each. **3**

OR

4. a) State Schrodinger's time independent wave equation. Derive an expression for energy of an electron confined to an infinite potential well of width L. **1+4**

b) Write physical significance of a wave function 'ψ'. **2**

c) An electron is confined to move in a one dimensional potential well of length 5 A°. Find the quantized energy values for the lowest two energy states. **3**

5. a) Show that FCC structure possesses least percentage void and maximum packing density amongst BCC and FCC crystal structure. **4**

b) Obtain relation between interplanar spacing (d) and lattice parameter (a) in cubic crystal system. **3**

c) Aluminium has a FCC structure. Its density is 2700 kg/m^3. Calculate the unit cell dimension and atomic diameter. Atomic weight of Al = 26.98. **3**

OR

6. a) Define : **2**
i) Unit cell ii) Space lattice

b) Draw planes (102) and (210) for simple cubic structure. **2**

c) Derive Bragg's law of X-ray diffraction. **3**

d) A beam of X-rays of $\lambda = 0.842$ A° is incident on a crystal at a glancing angle of 8.35°, where the first order Bragg's reflection occur. Calculate interplanar spacing and determine the glancing angle for the second order reflection. **3**

7. a) What is transistor ? Explain why in a transistor : **1+3**
i) emitter region is heavily doped and
ii) base region is narrow and weakly doped

b) Draw the energy band diagrams for - **3**
i) Forward biased p-n junction and
ii) Reverse biased p-n junction

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} atoms/m^3. Intrinsic carrier density at room temperature 300 K is 1.5×10^{16} carriers / m^3. **3**

OR

8. a) Explain hall effect. Derive an expression for hall voltage. **5**

b) Differentiate between drift and diffusion current. **2**

c) A specimen of Aluminium is 6×10^{-5} m thick. A current of 10 A flows through it and a magnetic field of induction 1.4 T is applied perpendicular to the current direction. The hall voltage developed is 10 μV. Determine the electron concentration in the material. **3**

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