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

Engineering Physics

P. Pages : 2 **NRT/KS/19/3282/3937**

Time : Two Hours * 0 1 1 7 * Max. Marks : 40

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

List of Constant

i) Planks constant $h = 6.63\times10^{-34}$ J – sec

ii) Mass of electron mo = 9.11×10^{-31} kg.

iii) Velocity of light $c = 3\times10^{8}$ m/s

iv) Charge of electron $e = 1.602\times10^{-19}$ C

v) Avogadro's Number $N_A = 6.023\times10^{26}$ atoms/kmol.

1. a) Explain Compton effect. Write an expression for Compton Shift. **2+1 =3**

b) Write equations of conservation of energy and momentum in Compton effect. **4**

c) Calculate de Broglie wavelength associated with an alpha particle accelerated by a potential difference of 25 K volts. **1+2 =3**
(mass of α particle $= 6.68\times10^{-27}$ kg. Charge of α-particle = 3.2×10^{-19} C)

OR

2. a) Describe in detail, Davisson and Germer's experiment to verify de Broglie hypothesis. **4**

b) Show that a free electron can not absorb a photon completely. **3**

c) A beam of X-rays is Scattered by loosely bound electrons at 45° from the direction of beam. The wavelength of Scattered X-rays is $0.22\,\mathring{A}$. What is the wavelength of incident X-rays? **3**

3. a) Define phase velocity and group velocity of a wave packet. What is wave packet? **2+1**

b) State Heisenberg's uncertainty principle and verify it with the help of thought experiment of electron diffraction through single slit. **1+3 =4**

c) An electron has a speed of 300m/s accurate to 0.001%. What is the minimum accuracy with which its position can be located? **3**

OR

4. a) Show that the wave function for a particle confined to one dimensional potential well of width 'ℓ' is given by $\psi_n(x) = \sqrt{\frac{2}{\ell}} \sin\left(\frac{n\pi x}{L}\right)$ where symbols have their usual meanings. **5**

b) Explain the phenomenon of "Barrier tunneling". **2**

c) An electron is trapped in 1-dimensional box of length 0.1nm. Calculate energy of first and third allowed energy state. **3**

5. a) Define the terms: **3**
i) Space lattice ii) Coordination no.
iii) Void space

b) Find expressions for atomic radii of FCC and BCC structures. **2+2 =4**

c) **3**
Nickel crystallizes in a FCC crystal. The edge of a unit cell is $3.52\,\text{Å}$. The atomic weight of Nickel is 58.710. Determine the density of Nickel.

OR

6. a) Define "Miller Indices" and draw planes in cubic system having Miller indices (110) and (121). **3**

b) Deduce relation between interplanar spacing and miller indices for a cubic crystal. **4**

X-rays with a wavelength of $1.54\,\text{Å}$ are used to calculate the spacing of (200) planes in aluminum. Bragg angle for this reflection is 22.4°. What is the size of unit cell of aluminium crystal? **3**

7. a) Show that for an intrinsic semiconductor the Fermi energy level lies at the middle of the band gap. **3**

b) **4**
Show that barrier potential is given by $V_o = \frac{kT}{e} \ell n\left(\frac{N_A \cdot N_D}{n_i^2}\right)$ where symbols have their usual meanings.

c) A strip of n-type germanium of width 0.5mm and thickness 1mm has a Hall coefficient $10^2\,m^3/C$. If the magnetic field used is 0.1T and current through the sample is 1mA, determine the Hall voltage produced. **3**

OR

8. a) Derive expression for "Hall voltage" in Hall effect. Also define and find expression for "Hall coefficient". **4**

b) Draw energy band diagram for Biased npn transistor. **3**

c) For npn transistor connected in CB mode, the emitter current is 3mA and base current is $25\,\mu A$. Find the values of collector current and current gain. **3**

****