VELAMMAL COLLEGE OF ENGINEERING & TECHNOLOGY

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DEPARTMENT OF PHYSICS

ANNA UNIVERSITY SOLVED PROBLEMS FOR I SEMESTER 2017 – 2018

1. Properties of Matter

1. A cantilever of length 50cm fixed at one end is depressed by 20mm at the loaded end. Calculate the depression at a distance of 40cm from the fixed end?
   Given data: l_1= 50cm, l_2 = 40cm, y_1 = 20mm; y_2 =?
   Formula: $20mm = \frac{W \times (50cm)^3}{3YI}$; $y_2 = \frac{W \times (40cm)^3}{3YI}$; $y_2 = \frac{l_2^3}{l_1^3} \times y_1$ **Ans : 19.84mm**

2. Determine the young's modulus of the material of a rod, if it is bend uniformly over two knife edges separated by a distance of 0.6m and loads of 2.5kg are hung at 0.18m away from the knife edges. The breadth and thickness of the rod are 0.025m and 0.005m respectively. The elevation at the middle of the rod is 0.0007m

   Given data: l = 0.6m; W = 2.5kg; a = 0.18m; b = 0.025m; d = 0.005m; y = 0.0007m
   Formula: $Y = \frac{3mgal^2}{2bd^3y}$; **Ans: Y = 1.088 x 10^{11} N/m^2.**
3. A copper wire of 3m length and 1mm diameter is subjected to a tension of 5N. Calculate the elongation produced in the wire if the young's modulus of elasticity of copper is 120GPa?
   Given data: F = 5N; L=3m; D=1mm (or) r = 0.5mm; Y = 120 x 10^9 Pa; l = ?
   Formula: $l = \frac{FL}{AY}$ **Ans: 15.9mm**

4. A wire of length 1mm is clamped at one of its ends. Calculate the couple required to twist the other end by 90°. Given rigidity modulus = 298GPa
   Given data: n = 298 x 10^9Pa, θ = 90° = π/2 radian, r = 0.5 x 10^{-3}m, L = 1m
   Formula: $C = \frac{\pi n \theta r^4}{2L}$ **Ans: C = 4.59 x 10^{-2} NM**

2. Oscillation and Waves, Lasers and Fiber optics

5. Calculate the critical angle, numerical aperture, acceptance angle and fractional index change of a given optical fiber whose refractive indices of core and cladding are 1.55 and 1.50 respectively.
   Given data : n_1 = 1.55; n_2 = 1.50 ; Formula : $\theta_c = \sin^{-1}\left(\frac{n_2}{n_1}\right)$; $N.A = \sqrt{n_1^2 - n_2^2}$;
   $\theta_0 = \sin^{-1}\left(\sqrt{n_1^2 - n_2^2}\right)$; $\Delta = \frac{n_1 - n_2}{n_1}$; Ans: θ_c = 75°24′ 26.8″; θ_0 = 22°59′ 11″; Δ = 0.033;
   N.A = 0.3905.

6. Optical fiber of 1mW is injected into a fiber of length 100m. The out coming signal from the other end is 0.3mW. Calculate the fiber attenuation in dB/Km.

   Given: P_{in} = 1mW; P_{out} = 0.3mW; L = 100 x 10^{-3}Km; Formula $\alpha = \frac{10}{L}\log\left(\frac{P_{in}}{P_{out}}\right)$

   Ans: $\alpha = 52.28\ dB/Km$

3. Thermal Physics

7. A rod of 0.25m long and 0.892 x $10^{-4}m^2$ area of cross section is heat at one end through 393K while the other end is kept at 323K. The quality of heat which flow in 15 minutes along the rod is 8.811 x 10^3 J. Calculate the thermal conductivity of rod?
   Given data: θ_1 = 393K; θ_2 = 323K; Q =8.811 x 10^3J; t = 15 min = 15 x 60 = 900sec;

   Formula: $K = \frac{Qx}{A(\theta_1 - \theta_2)t}$ **Ans: 392Wm^{-1}K^{-1}**

8. The outer ends of two bars A & B (inner ends of which are joined together by welding) are at 100˚C and 50˚C. if they have the same area of cross section and the same length and their thermal conductivities are in the ratio of A:B = 7:5. **Solve** the temperature at the welded joint
   Given data: K_1: K_2 = 7:5 $d_1 = d_2$, θ_1 = 100°C, θ_2 = 50°C

   Formula: $\frac{K_1}{d_1}A(\theta_1 - \theta) = \frac{K_2}{d_2}A(\theta - \theta_2)$ **Ans: θ = 79.166°C**

4. Quantum Physics

9. Calculate the deBroglie wavelength of an electron accelerated with potential difference of 400 volts?

   Given data: V = 400v ; Formula $\lambda = \frac{12.26}{\sqrt{V}}\dot{A}$; **Ans: 0.613Å**

10. Calculate the deBroglie wavelength of neutron moving with K.E of 0.025eV with mass 1.674 x 10^{-27}Kg?

    Given: E = 0.025 x 1.6 x 10^{-19}J ; m = 1.674 x 10^{-27}Kg; Formula: $\lambda = \frac{h}{\sqrt{2mE}}$; **Ans: 0.181nm**

11. In Compton scattering, the incident photon have wavelength 0.5nm. Calculate the wave length of the scattered radiation if they are viewed at an angle of 45° to the direction of incidence
    Given date: λ = 0.5 x 10^{-9}m; θ = 45°; h = 6.626 x 10^{-34}Js^{-1}; c = 3 x 10^8m/s; m_0 = 9.11 x 10^{-31}Kg

    Formula: $\lambda' = \lambda + \frac{h}{m_0 c}(1 - \cos\theta)$; **Ans: 0.5007nm**

12. Calculate the minimum energy, an electron can possess, in an infinite potential well of width 4nm?
    Given data: n =1; a = 4 x 10^{-9}m; h = 6.626 x 10^{-34}; C = 3 x 10^8m/s ;

    Formula: $E = \frac{n^2h^2}{8ma^2}$ **Ans: 3.76 x 10^{-21}j (or) 0.0235eV**

5. Crystal Physics

13. Iron has BCC Structure with atomic radius 0.123Å. Find the lattice constant and volume of the unit cell?

    Given data: r = 0.123 x 10^{-10}m ; Å ; Formula: $a = \frac{4r}{\sqrt{3}}$; V = a^3

    Ans: a = 0.284 ; V = 2.2906 x 10^{-28} m^3

14. In a simple cubic system, the closest distance between its neighboring atoms is 2.62Å. Calculate the spacing between (1 0 0), (1 1 0) and (1 1 1) planes?
    Given data: (h k l) = (1 0 0), (1 1 0) & (1 1 1) ; a = 2.62 x 10^{-10}m

    Formula: $d = \frac{a}{\sqrt{h^2 + k^2 + l^2}}$ Ans: **2.62Å; 1.85 Å, 1.51Å**

15. Sketch (1 0 0) , (1 1 0), (1 1 1) & (1 2 0) planes for the cubic systems?