Hall Ticket No | | | | | | | | | | | Question Paper Code: AHSB04

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

B.Tech II Semester End Examinations (Regular) - May, 2019

Regulation: IARE – R18

WAVES AND OPTICS

Time: 3 Hours **(Common to EEE | CE)** **Max Marks: 70**

Answer ONE Question from each Unit
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

UNIT – I

1. (a) Discuss the de-Broglie's hypothesis of duality of material particles. Describe Davisson and Germer's experiment to prove the existence of matter waves. **[7M]**
   (b) Calculate the wavelength associated with an electron having energy 2000 eV. **[7M]**
2. (a) Explain the concept of Black body radiation, Photoelectric effect and Compton effect. **[7M]**
   (b) Calculate the energies that can be possessed by a particle of mass 8.50 x10^{-31} kg which is placed in an infinite potential box of width 10^{-9}m. . **[7M]**

UNIT – II

3. (a) Define a semiconductor and draw its band diagram to explain its electronic behavior. Explain the origin of energy band formation in solids. **[7M]**
   (b) In Intrinsic semi conductor Si at 300 K, n_i= 2.4 x 10^{19} / m^3 and mobilities of electron and holes are 0.135 m^2/Vs and 0.048 m^2/Vs. Calculate conductivity of the sample. **[7M]**
4. (a) Distinguish between intrinsic and extrinsic semiconductors. Indicate on an energy level diagram, the conduction and valence bands, donor and acceptor levels for intrinsic and extrinsic semiconductors. **[7M]**
   (b) Calculate the density of charge carriers of semiconductor, given the Hall efficient is -6.85 $\times$ 10^{-5} m^3/Coulomb. **[7M]**

UNIT – III

5. (a) Outline the characteristics of laser. Explain construction and working of Ruby laser with neat diagrams. **[7M]**
   (b) Calculate the fractional index change for a given optical fiber if the refractive indices of the core and the cladding are 1.563 and 1.498 respectively. **[7M]**
6. (a) Define acceptance angle and numerical aperture. Deduce the expressions for acceptance angle and numerical aperture. **[7M]**
   (b) An optical fiber has refractive index of core and cladding 1.48 and 1.45 respectively. Find the acceptance angle in water which has refractive index of 1.33. **[7M]**

UNIT – IV

7. (a) Explain how Newton's rings are formed in reflected light. Derive an expression for diameters of bright and dark rings. **[7M]**

   (b) In Newton's rings system if the diameter of 4th and 6th dark rings are 3 mm and 3.6 mm, calculate the wavelength of the light used. The radius of curvature of the convex surface of the lens is 0.9 m. **[7M]**

8. (a) What is plane diffraction grating? Explain how it is used to determine the wavelength of a spectral line of a given source of light. **[7M]**

   (b) A plane diffraction grating has the value of grating constant equal to $15x10^{-4}$ cm. Calculate the position of the third order maximum for $\lambda = 2.4 \times 10^{-4}$ cm. **[7M]**

UNIT – V

9. (a) Define simple harmonic motion. Derive the equation of SHM. **[7M]**

   (b) A spring is stretched by 8 cm by a force of 10 N. Find the force constant. What will be the period of 4 kg mass suspended by it? **[7M]**

10. (a) Explain damped oscillation and forced oscillation. **[7M]**

    (b) A particle of mass 5 gm executes SHM and has amplitude of 8 cm. If it makes 16 vibrations per second, find its maximum velocity and energy at mean position. **[7M]**

Constants

Mass of Electron: 9.1×10^{-31} Kg

Mass of neutron: 1.676×10^{-27} Kg

Planck's constant: 6.625×10^{-34} joule-seconds

Velocity of light: 3×10^{8} m/s

Permittivity of free space: 8.85×10^{-12} F/m

Permeability of free space: $4\pi \times 10^{-7}$ N A^{-2}

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