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

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Four Year B.Tech I Semester End Examinations(Regular) - December, 2019
Regulation: IARE – R18
WAVES AND OPTICS
Time: 3 Hours   (Common to AE | ME | ECE)   **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) Compare a particle with a wave and discuss about dual nature of radiation. **[7M]**

   (b) Describe the phenomena of photoelectric effect with experimental arrangement. **[7M]**

2. (a) Obtain the 3-dimensional, time independent Schrodinger's wave equation for an electron. **[7M]**

   (b) An electron is confined to a one dimensional potential box of length $2\ A^0$. Calculate the energies corresponding to the second and fourth quantum states. **[7M]**

UNIT – II

3. (a) Define a metallic solid and draw its band diagram to discuss its electronic behavior. Explain the origin of energy band formation in solids **[7M]**

   (b) Using Kronig-Penny model show that the energy spectrum of an electron contains a number of allowed energy bands separated by forbidden bands. **[7M]**

4. (a) Discuss in detail Hall effect and obtain an expression for Hall coefficient. Mention the uses of Hall effect. **[7M]**

   (b) Find the Hall voltage in a Si doped with 10^{23} phosphorous atoms per m^3. The Si sample is 100 µm thick with a current flow of 10^{-3} A for a magnetic field of 10^{-1} Wb/m^2. **[7M]**

UNIT – III

5. (a) What are the different types of lasers ? Describe construction and working of He-Ne laser. **[7M]**

   (b) Calculate the wavelength of emitted radiation from a semiconductor diode laser, which has a band gap of 1.68eV. **[7M]**

6. (a) Why all the light rays incident on optical fiber cannot propagate through fiber? Obtain the maximum angle of acceptance of a step index fiber. **[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]**

UNIT – IV

7. (a) How Newton's rings are formed? Obtain the expressions for diameters of dark rings and bright rings. Why center spot of the newton rings always dark in reflected light **[7M]**

   (b) Newton's rings are observed in the reflected light of wavelength $5900A^o$. The diameter of fifth ring and tenth dark ring is 0.2 cm and 0.5 cm. Find the radius of curvature of the lens used.
   [7M]

8. (a) Explain construction and working of Michelson interferometer. Discuss about fringe pattern.
   [7M]

   (b) Two slits separated by a distance of 0.2 mm are illuminated by a monochromatic light of wavelength 550 nm. Calculate the fringe width on a screen at distance of 1 m from the slits.
   [7M]

UNIT – V

9. (a) What are the conditions for a particle to be in SHM. Distinguish between free and forced oscillations. **[7M]**

   (b) An oscillator is subjected to external periodic force and damping force proportional to its velocity. Set up differential equation of the oscillator. What is steady state solution to this differential equation. **[7M]**

10. (a) Explain diagrammatically, how are first three harmonics produced in a wire fixed at two ends and plucked. **[7M]**

   (b) A body of mass 0.05kg executes SHM. When the displacement from the center of motion is 0.04m, the force acting on the body is 0.018N. If the maximum velocity is 2m/s, find the amplitude.
   [7M]