

C 196

B.E./B.Tech. DEGREE EXAMINATION, JANUARY 2006.

First Semester

PH 1101 — PHYSICS — I

(Common to all branches of Engineering and Technology)

(Regulations 2004)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. If the intensity of a source of sound is increased to 20 times its value, by how many decibel does the intensity level increase?
2. Describe a laboratory experiment to determine the velocity of ultrasonic waves in a given liquid by forming an acoustic grating.
3. The unit cell edges a , b and c of an orthorhombic crystal are 0.05 nm, 0.04 nm and 0.03 nm respectively. Of a family of parallel, equidistant planes, the one that is closest to the origin of the unit cell makes intercepts on the a , b and c edges at 0.025 nm, 0.02 nm and 0.01 nm respectively. Find the Miller indices of the set of parallel planes.
4. Mention any four requisites of a good liquid penetrant used in liquid penetrant non-destructive testing.
5. An air wedge is formed between two glass plates of length 10 cm. each, with a fine insulated wire kept between the plates at one end. When illuminated with sodium light of wavelength 589.3 nm, 100 fringes are seen in 1 cm. With the insulation removed, 60 fringes are seen in 1 cm. Calculate the diameter of the wire and the thickness of insulation coating.
6. What is meant by photo elastic effect?
7. The photoelectric work function of aluminium is 4.2 eV. Calculate the kinetic energy of fastest photoelectron when light of wavelength 200 nm is incident on an aluminium surface ($1 \text{ eV} = 1.6 \times 10^{-19} \text{ J}$; $h = 6.62 \times 10^{-34} \text{ Js}$ and $c = 3 \times 10^8 \text{ ms}^{-1}$).

8. Mention the physical significance of wave function of Schrodinger's wave equation.
9. Mention any four advantages of LED in electronic display.
10. The refractive index of core and cladding materials of an optical fibre are 1.54 and 1.5 respectively. Calculate the numerical aperture of the optical fibre.

PART B — (5 × 16 = 80 marks)

11. (i) With a neat diagram, explain the construction and working of CO₂ laser. (12)
- (ii) Mention any four advantages of fibre optic sensors. (4)
12. (a) Derive expressions for growth and decay of energy density inside a hall and hence deduce Sabine's formula for the reverberation time of the hall. (16)

Or

- (b) (i) Draw the circuit diagram of piezo-electric oscillator and explain the production of ultrasonic waves using it. (10)
- (ii) Explain the application of ultrasonics in SONAR and blood flow measurement. (3 + 3)
13. (a) (i) Define packing factor and derive an expression for packing factor of *hcp* structure. (2 + 10)
- (ii) Magnesium has *hcp* structure. The radius of magnesium atom is 0.1605 nm. Calculate the volume of the unit cell of magnesium. (4)

Or

- (b) (i) Draw the block diagram of an ultrasonic flaw detector and explain the function of its various components. (5 + 5)
- (ii) Explain the tube shift method of finding the depth of a flaw in a material using X-rays. (6)

14. (a) (i) Describe the construction and working of Michelson's interferometer. Also explain, with necessary theory, a laboratory experiment of finding the wavelength of a monochromatic source of light using Michelson's interferometer. (6 + 6)

(ii) When a thin film of glass of refractive index 1.5 is interposed in the path of one of the interfering beams of Michelson's interferometer, a shift of 30 fringes of sodium light is observed across the field of view. If the thickness of the glass film is 0.018 mm, calculate the wavelength of the light used. (4)

Or

(b) (i) Explain in detail the methods of detecting plane, circularly and elliptically polarized lights. (4 + 4 + 4)

(ii) Calculate the thickness of a mica sheet required for making a half-wave plate for a light of wavelength 546.1 nm. The indices of refraction of mica for the ordinary and extraordinary rays for the given light, respectively are 1.586 and 1.592. (4)

15. (a) (i) Explain Compton effect and derive an expression for the wavelength of scattered photon. (2 + 10)

(ii) X-rays of wavelength 0.1 nm are scattered from a carbon block. Find the wavelength of the scattered beam in a direction making an angle of 90° with the incident beam ($m_0 = 9.11 \times 10^{-31}$ kg). (4)

Or

(b) (i) Derive an expression for energy levels of a particle enclosed in one-dimensional potential box of width a and infinite height. (12)

(ii) Calculate the least energy that an electron can possess in a one-dimensional potential box of width 0.5 nm and infinite height. ($m = 9.11 \times 10^{-31}$ kg). (4)