B.Tech. (ME) 3rd Semester (G-Scheme)

Examination, December–2024

PHYSICS-II (OPTICS AND WAVES)

Paper-BSC-ME-201G

Time allowed : 3 hours] *[Maximum marks : 75*

Note : *Attempt **five** questions in all selectign **one** from each section. **Question no.1 is compulsory.** All questions carry equal marks.*

1. (a) The displacement of a particle executing SHM is given by $x = 0.01 \sin 100\pi(t+0.05)$ determine the amplitude, time period and frequency of SHM.

(b) Explain the phenomenon of total internal reflection with the help of a neat diagram.

(c) Two waves of amplitude 4 and 2 units are superposed with their vibrations parallel. Deduce the ratio of the maximum to minimum intensity as phase relation varies.

(d) What are transverse and longitudinal waves? Give two examples of each.

(e) Differentiate between spontaneous and stimulated emission.

(f) What is laser pumping? Discuss different methods of laser pumping.

$6 \times 2.5 = 15$

Section-1

2. What do you understand by simple harmonic motion? Obtain the differential equation for simple harmonic motion of a simple pendulum and derive the expression for total energy of simple pendulum. 15

3. What is forced harmonic oscillator? Write its differential equation and discuss the steady state of a forced harmonic oscillator subjected to an external periodic force. Discuss the condition of resonance in terms of natural and driving frequency. 15

Section-2

4. (a) Derive the expression for the velocity of longitudinal waves in the solid. 7

   (b) What is the matrix method in paraxial Optics? How can the matrix method be applied to translation and refraction problem? 8

5. Write Fresnel's equation in nonconducting isotropic media when electric field vector E is perpendicular to the plane of incidence (TM mode) and hence derive the relation for transmission and reflection coefficient. 15

Section-3

6. (a) Explain the formation of interference fringes in Newtons' ring experiment in reflected system of light. Derive the expression for measurement of the wavelength of light. 12

(b) In a Newton's ring experiment, the diameter of 5^{th} and 25^{th} rings are 0.3 cm and 0.8 cm respectively. Find the wavelength of light, R = 100 cm. 3

7. Distinguish between Fraunhofer and Fresnel type of diffraction. Discuss analytically the intensity distribution in Fraunhofer diffraction at a single slit. 15

Section-4

8. (a) Describe the principle, construction and working of Nd:YAG laser. 12

(b) Which one is better Ruby laser or He-Ne- laser? Explain. 3

9. (a) Explain the concept of directionality, intensity, monochromaticity and coherence as applied to lasers. 10

(b) Discuss at least six applications of lasers in detail. 5