2022
B.A./B.Sc.
Third Semester
GENERIC ELECTIVE – 3
PHYSICS
Course Code: PHG 3.11
(Waves & Optics)

Total Mark: 70 *Pass Mark: 28*
Time: 3 hours

Answer five *questions, taking* one *from each unit.*

UNIT–I

1. (a) Show that the resultant of two SHMs of the same period but of different amplitudes and phases, in perpendicular directions, is an elliptic motion. For what conditions may the path be a straight line? 8
   (b) Explain the superposition of two collinear harmonic oscillations of equal frequencies. 3
   (c) In a gaseous medium the frequency of a sound wave is 512 Hz, amplitude 1.2 cm and velocity 320 m/s. If the density of the medium be 1.426×10^{-3} gm/cc, calculate energy density and intensity of the wave. 3

2. (a) Derive an expression for the velocity of transverse waves in a string under tension. Find the expression for the fundamental frequency of its vibration. 5+3=8
   (b) Derive the expression for group velocity and phase velocity. 4
   (c) A string of length 0.99 m and mass 1 g is stretched by tension *T*. The string vibrates in three segments with a frequency 500 Hz. Find the tension in the string. 2

UNIT–II

3. (a) Describe Poiseuille's method for measuring the coefficient of viscosity of a liquid. 6

(b) Define surface tension of a liquid. Derive an expression for the excess pressure inside a soap bubble. 5

(c) Calculate the mass of water flowing in 10 minutes through a tube 0.001 m diameter and 0.4 m long if there is a constant pressure head of 0.2 m of water. The coefficient of viscosity of water is $0.00082\ Nsm^{-2}$. 3

4. (a) State Fourier's theorem. Expand a square wave into Fourier series and use Fourier's theorem for the analysis of a square wave. 2+4=6

(b) Derive Sabine's expression for reverberation time. 6

(c) Calculate the change in intensity level when the intensity of sound increases 100 times its original intensity. 2

UNIT–III

5. (a) Give the statements of Huygens' principle of propagation of wave front. 2

(b) Discuss the basic conditions for interference to take place. 2

(c) Give Stokes' treatment to explain change of phase when reflection takes place at a denser medium. 4

(d) Discuss the interference in thin films due to reflected light. Hence obtain conditions for bright and dark fringes. 4+2=6

6. (a) What are Haidinger fringes? 2

(b) Discuss the formation of Newton's rings by reflected light. Derive an expression for radius of the *n*th bright and dark ring in case of reflected light. Describe the method for the measurement of wavelength of light using Newton's rings. 2+5+2=9

(c) Newton's rings are observed in reflected light of wavelength $\lambda = 5.9 \times 10^{-7}$ m . The diameter of the 10th dark ring is 0.5 cm. Find the radius of curvature of the lens and the thickness of the air film. 3

UNIT–IV

7. (a) Briefly describe the construction of Michelson's interferometer. How can it be used to measure the wavelength of a monochromatic light. 6+5=11

(b) The wavelength of two components of D-lines of sodium are 5890 Å and 5896 Å. By how much distance one of the mirrors of Michelson's interferometer should be moved so as to obtain consecutive positions of maximum distinctness. 3

8. (a) State Brewster's law. 2
   (b) Show that the plane polarized and circular polarized lights are special cases of elliptically polarized light. 6
   (c) What is holography? Describe the recording and reconstruction processes in holography with the help of suitable diagrams. 2+4=6

UNIT–V

9. (a) What is diffraction of light? Distinguish between Fresnel and Fraunhofer diffraction. 2+3=5
   (b) Obtain an expression for intensity distribution for Fraunhofer diffraction in case of double slit. 6
   (c) In Fraunhofer diffraction pattern due to a narrow slit, a screen is placed 2 m away from the lens to obtain the pattern. If the slit width is 0.2 mm and the first minima lie 5 mm on either side of the central maximum, find the wavelength of light. 3

10. (a) What are Fresnel half period zones? Show that the resultant amplitude at a point due to whole wave front is equal to half of the amplitude due to first half period zone at that point. 2+6=8
    (b) What is a zone plate? Write down the expression for its focal length. 3
    (c) A plane wave front of light of wavelength 5×10^{-7} m falls on an aperture and the diffraction pattern is observed in an eyepiece at a distance of 1 m from the aperture. Find the radius of the 100th half period element and the area of a half period zone. 3
