**October 2025**
**B.A./B.Sc.**
**Third Semester**
MAJOR – 4
**PHYSICS**
*Course Code: PHM 3.21*
(Waves & Optics)

*Total Mark: 50* *Pass Mark: 20*
*Time: 2 hours*

*I. Answer* three *questions, taking* one *from each unit.*

## UNIT–I

1. (a) Derive an expression for the velocity of transverse vibrations of stretched string. 6
   (b) Discuss the analytical treatment of the superposition of two harmonic waves on a string. 4
   (c) If the frequency of a tuning fork is 400 Hz and the velocity of sound in air is 320 m/s, determine how far the sound travels while the tuning fork makes 30 vibrations. 2

2. (a) A particle is subjected simultaneously to two SHM of the same period but of different amplitudes and phases in perpendicular directions. Find the expression for the resultant motion. For what condition the path may be a straight line and circle. 6
   (b) Differentiate between longitudinal and transverse waves. Give one example each. 4
   (c) A tuning fork produces sound waves of wavelength 68 cm. If the velocity of sound is 340 m/s, what is the frequency of tuning fork? 2

## UNIT–II

3. (a) Derive an expression for fringe width in Young's double-slit experiment and discuss the conditions for sustained interference. 6
   (b) Explain the difference between the division of amplitude and the division of wavefront, with examples. 4

(c) In a Newton's rings experiment, the diameter of the $15^{th}$ ring was found to be 0.590 cm and that of the $5^{th}$ ring was 0.336 cm. If the radius of the plano-convex lens is 100 cm, calculate the wavelength of light used. 2

4. (a) Explain the construction and working of Michelson's interferometer. How is it used to determine the wavelength of light and the refractive index? 6
   (b) Define temporal and spatial coherence. Discuss their importance in interference experiments. 4
   (c) Newton's rings are observed in reflected light of wavelength $5.9 \times 10^{-7}$ m. The diameter of $10^{th}$ dark ring is 0.5 cm. Find the radius of curvature of the lens and the thickness of the air film. 2

## UNIT–III

5. (a) Explain the theory of a zone plate and show how it can produce multiple foci. Compare its action with that of a convex lens. 6
   (b) Distinguish between Fraunhofer and Fresnel diffraction with suitable examples. 4
   (c) Write Fresnel's assumptions in diffraction theory. 2

6. (a) Derive the intensity distribution for Fraunhofer diffraction due to a single slit and discuss the conditions for principal and secondary maxima. 6
   (b) Explain the importance of Fresnel integrals in diffraction theory? 4
   (c) What is meant by resolving power of an optical instrument? 2

*II. Answer* <u>any two</u> *questions from the following.*

## UNIT–I

7. (a) Derive the general differential equation of a plane progressive wave. 5
   (b) Define beat frequency. 2

## UNIT–II

8. (a) Explain the principle and formation of interference fringes using Lloyd's mirror. 5
   (b) State Huygens' principle. 2

## UNIT–III

9. (a) Describe the phenomenon of Fresnel's pattern due to a straight edge. 5
   (b) What is the essential condition for Fraunhofer diffraction. 2