

June : 2026

PHYSICS

Paper: PHY-M-201

Waves & Optics**Time: 2½ Hours****Total Mark: 60***(The figures in the right margin indicate full marks of the questions)*

- 1 Choose the correct answer: 1×6 = 6
- (i) If two harmonic oscillations of equal frequency are superimposed at right angles with a phase difference of $\frac{\pi}{2}$ and equal amplitudes, the resulting Lissajous figure is:
- a) straight line b) an ellipse
 c) a circle d) a parabola
- (ii) The velocity of sound in air, as corrected by Laplace, depends on the ratio of specific heats (γ) and is given by the formula:
- a) $v = \sqrt{\frac{P}{\rho}}$ b) $v = \sqrt{\frac{\gamma P}{\rho}}$
 c) $v = \sqrt{\frac{P}{\gamma \rho}}$ d) $v = \gamma \sqrt{\frac{P}{\rho}}$
- (iii) In a standing wave, the distance between a node and the adjacent antinode is equal to:
- a) λ b) $\frac{\lambda}{2}$
 c) $\frac{\lambda}{4}$ d) 2λ
- (iv) Two sources of light are said to be coherent if they emit light waves of:
- a) Same amplitude

b) Constant phase difference

c) Different wavelengths

d) Same intensity but different frequencies

(v) The radius of the n^{th} dark Newton's ring in reflected light is proportional to:

a) n

b) n^2

c) $\sqrt{n}$

d) $\frac{1}{n}$

(vi) When light is incident at the polarizing angle (Brewster's angle), the angle between the reflected and refracted rays is:

a) 0°

b) 45°

c) 90°

d) 180°

2. Find expression for fundamental frequencies of longitudinal standing wave in open and closed pipe with necessary diagram. 3+3=6

Or

Discuss formation of standing wave in a string when both ends are fixed. 6

3. A transverse wave in a stretched string is described by $y = 0.05 \sin(2.0x - 40t)$, where x and y are in meters. Calculate the wave velocity and the maximum particle velocity. 4

Or

Compare and contrast the characteristics of stationary waves with travelling waves in terms of energy transport and the phase relationship between particles. 4

4. In a Newton's rings experiment, the diameter of the 10^{th} dark ring is 0.5 cm. Calculate the wavelength of light used if the radius of curvature of the lens is 100 cm. 4

Or

2

Deduce the condition for destructive interference in thin parallel films when observed by light reflected from the upper and lower surfaces. 4

5. (a) Derive an expression for the resultant amplitude of N collinear harmonic oscillations of equal frequency and equal phase difference. 5

(b) Define the Principle of Superposition. 2

6. (a) Derive Newton's formula for the velocity of sound in air. 3

(b) Explain why Laplace's correction was necessary and derive the corrected formula. 4

Or

(a) Establish the differential equation for the velocity of longitudinal waves in a fluid. 5

(b) Distinguish between plane and spherical waves. 2

7. (a) Define wave front and discuss its properties. 1+2=3

Or

(b) Explain Huygen's Principle with diagram. 3

8. (a) Discuss the theory of interference in a wedge-shaped thin film and derive the fringe width expression. 4

(b) A beam of light having a wavelength $\lambda = 589 \text{ nm}$ is incident on a film of $\mu = 1.5$. Calculate the minimum thickness for the film to appear dark. 2

9. Answer any two of the following— 7×2=14

i) (a) Explain Fresnel's assumptions for half-period zones and show that the area of each zone is constant. 5

- (b) State the principle of rectilinear propagation of light based on Fresnel's theory. 2
- ii) (a) Describe the theory of a Zone Plate and show that it has multiple foci. 4
- (b) A plane wave of $\lambda = 600 \text{ nm}$ falls on a slit of 0.1 mm . Calculate the angular width of the central maximum. 3
- iii) (a) Distinguish between Fresnel's diffraction pattern and Fraunhofer diffraction. 3
- (b) Discuss Fresnel's diffraction pattern at a straight edge. 4
10. (a) State Brewster's Law and show that at the polarising angle, the reflected and refracted rays are perpendicular. 3

Or

- (b) Calculate the thickness of a quarter-wave plate for $\lambda = 500 \text{ nm}$ ($\mu_0 = 1.54$, $\mu_e = 1.55$). 3
