

U.G. 2nd Semester Examination - 2023**PHYSICS****[HONOURS]****Course Code : PHY-H-CC-T-04****(Waves & Optics)**

Full Marks : 40

Time : $2\frac{1}{2}$ Hours*The figures in the right-hand margin indicate marks.**Candidates are required to give their answers in their own words as far as practicable.***GROUP-A**

1. Answer any five questions:

 $2 \times 5 = 10$

- a) Show that acoustic pressure satisfies the differential wave equation.
- b) What are Newton's rings?
- c) Why is it necessary to use narrow source for Biprism and extended source for Newton's ring?
- d) In the transverse arrangement of Melde's experiment, the string vibrates in 3 loops when the tension is 0.32Kgt. Determine the tension when the string vibrates in 2 loops in the longitudinal arrangement.

[Turn Over]

- e) What is the basic principle of holography?
- f) What is non reflecting? Give one application of it.
- g) The displacement equation of a simple harmonic oscillator is $x = a \sin(\omega t + \phi)$. Find out a relation between velocity (v) and acceleration(f).
- h) Explain how conservation of energy is obeyed in interference.

GROUP-B

2. Answer any **two** questions: 5×2=10
- a) Explain how the Newton's ring experiment can be used to determine the refractive index of an unknown liquid. Give proper diagram. 5
 - b) Calculate the minimum thickness of coating on a glass plate so that the surface acts as non reflecting. (Assume the refractive index of coating material is n_c). 5
 - c) Explain in brief how does straight fringes are produced in Michelson Interferometer. Give proper diagram. 5

- d) Two rectangular simple harmonic motion having small frequency difference $\Delta\omega$. Show that the resultant pattern will be repeated after a time $T = \frac{2\pi}{\Delta\omega}$. Draw the Lissajous figures resulting from two rectangular simple harmonic motion having frequency ratio 1:2 at phase differences $0, \pi/4, \pi/2, 3\pi/4, \pi$.

2+3

GROUP-C

Answer any **two** questions:

10×2=20

3. a) The displacement of a stationary wave at any point 'x' and at any time 't' is given by $Y(x,t) = 2a \cos Kx \cos \omega t$. Show that average energy density of a stationary wave is $\bar{E} = \rho_0 a^2 \omega^2$, where ρ_0 is the density of the medium, a is amplitude, ω is the angular frequency, and K is propagation constant.
- b) Discuss the phenomena of Fraunhofer diffraction in a double slit with proper diagram.

6+4

4. a) The phase velocity v of deep water wave of wavelength λ is given by $v^2 = \frac{g\lambda}{2\pi} + \frac{2\pi s}{\rho\lambda}$, where S is the surface tension, g is gravitational acceleration, ρ is the density of liquid. (i) Find the wavelength λ_0 of the waves which do not disperse in water. (ii) Show that for wavelength $\lambda \ll \lambda_0$ the group velocity v_g is v_g is $\frac{3v}{2}$.
- b) Show that the resolving power increases with the total no of lines of the grating element.
(2+4)+4
5. a) For a plucked string show that the amplitude of the s -th harmonic is proportional to $1/s^2$.
- b) Define resolving power of a grating with proper diagram.
6+4
6. a) With proper diagram, describe briefly the Fresnel's half period zones for plane wave.
- b) Calculate the radius and area of n^{th} zone of Fresnel's half period zones.
- c) What is the difference between convex lens and zone plate.
5+3+2