U.G. 2nd Semester Examination - 2023

PHYSICS

[HONOURS]

Course Code : PHY-H-CC-T-04

(Waves & Optics)

Full Marks : 40 Time : 2½ 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 0.32Kgwt. Determine the tension when the string vibrates in 2 loops in the longitudinal arrangement.

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 $x = a\,Sin(\omega t + \varphi)$. 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: $5 \times 2 = 10$

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 Δ_ω. 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 ditferences $0, \pi/4, \pi/2, 3\pi/4, \pi$.

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 $Y(x,t) = 2a\,CosKx\,Cos\,\omega t$. 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

Over

4 a) The phase velocity v of deep water wave of wavelength λ is given by $v^2 = \frac{g\lambda}{2\pi} + \frac{2\pi s}{p\lambda}$, 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 $\lambda << \lambda_0$ the group velocity vg 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