2019

B.Sc.

2nd Semester Examination

PHYSICS (Honours)

Paper - C4T

Full Marks : 40 Time : 2 Hours

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

1. Answer any *five* questions : 2×5=10

(a) Prove that $C_g = C_p - \lambda \frac{dC_p}{d_\lambda}$

for a group of waves.

Where C_g = group velocity

C_p = phase velocity

λ = wave length.

[Turn Over]

(b) Show that the acoustic pressure satisfies the wave equation.

(c) The Intensity of a source is n dB. If N such sources emits sound simultaneously, show that the intensity level is $(n+10\log_{10} N)$dB.

(d) In Melde's experiment, the string vibrates in 5 loops when the tension is T. If T is increased by 0.05 kg – wt, the number of loops becomes 4. Calculate T.

(e) What do you mean by 'fringes of equal width' and 'equal inclination' ?

(f) In a grating spectra, how many orders would be visible if the wavelength of incident light is 600 nm and number of lines in the grating is 500 per m.m. ?

(g) What are the similarities and dis-similarities between convex lens and Zone plate ?

(h) In a Lloyd's mirror-experiment calculate the ratio of the intensities at the interference maxima and minima if the mirror reflects only 75% of the light incident upon it.

2. Answer any *four* questions : 5×4=20

(a) Why is it necessary to use narrow source for Fresnel's biprism and extended source for

Newtons ring experiment ? How can you measure the thickness of a thin transparent film with biprism experiment ? 2+3

(b) Find an expression for the intensity of Fraunhofer diffraction pattern due to single slit. Discuss the conditions for maxima and minima. 3+2

(c) Give a ray diagram of the light path in Michelson's Interferometer. What is the role of the compensator in Michelson interferometer ? What would be the change in interference pattern when monochromatic light is replaced by white light ? 2+1+2

(d) Find the differential equation for the transverse vibration of a stretched string. Define eigen Functions, eigen values and eigen Frequencies. 3+2

(e) (i) Prove that the resultant of superposition of n number of simple harmonic motions having the same amplitude a and the same angular frequency ω, but equal successive phase advancement δ is given by

$$x = a\frac{\sin\left(n\delta/2\right)}{\sin\left(\delta/2\right)}\cos\left(\omega t + (n-1)\delta/2\right)$$

(ii) Show that the average kinetic and potential energies of a particle in SHM are half the total energy. 3+2

(f) What is acoustic intensity ? Show that the acoustic intensity for a plane progressive harmonic wave is the product of the rms acoustic pressure and rms particle velocity. 2+3

3. Answer any *one* question. 10×1=10

(a) (i) A stretched string of length l fixed at its ends, is plucked by a distance b at a point distant a From one of its ends. Find the energy of the Sth harmonic given that the displacement at a point x on the string at time t for the Sth harmonic

$$Y_s(x,t) = A_s \sin\frac{S\pi x}{L}\cos\frac{S\pi ct}{L}$$

A_s = amplitude of Sth harmonic. 5

(ii) Two plane progressive harmonic waves of same frequency and unequal amplitudes, propagating in opposite directions along the

x axis superimpose. Show that the resultant wave consists of a stationary wave and a progressing wave moving along the x-axis. 5

(b) (i) A beam of plane monochromatic light from an extended source falls on a thin film. Find the conditions for the film to have maximum or minimum brightness on producing interference.

Show that the interference fringes are complementary to each other for reflected and transmitted beam. 3+4

(ii) Newton's rings are formed with a source of light containing two wavelengths λ_1 and λ_2, if the mth order dark ring due to λ_1 consider with $(m+1)$ th order darkring due to λ_2, prove that the radius of the mth dark ring of λ_1 is equal to $\sqrt{\frac{\lambda_1\lambda_2 R}{\lambda_1-\lambda_2}}$, where R is the radius of curvature of the lower curved surface. 3