performing transverse vibrations, the displacement at a point x at time t is given by

$$y(x,t) = \sum_{S=1}^{\infty} \frac{A}{S} \sin\frac{S\pi a}{L} \sin\frac{S\pi a}{L} \sin\frac{S\pi ct}{L}$$

where L is the length of the string, X = a is the point of excitation, S = 1, 2, 3, ..., A = constant and c is the velocity of the transverse wave along the string.

(i) Find the initial displacement at a point x.

(ii) Calculate the frequency and wavelength of the fundamental tone. Represent this mode of vibration diagrammatically.

(iii) The string is excited at x = L/3 and touched at x = L/4. Calculate the harmonic present.

1+(1+1+1)+2

(b) Show that the energy of vibration of a stretched string for a particular node varies as the square of the eigen frequency and square of the amplitude for that mode. 4

16. (a) What are the difference Fresnel's and Fraunhofer diffraction. 2

(b) Obtain the intensity expression for Fraunhofer diffraction pattern of a double slit. Deduce the conditions for maximum and minima. What is missing order. 4+2+1

(c) What is the difference between a grating spectrum and prism spectrum. 1

2018

2nd Semester

PHYSICS

PAPER—C4T

(Honours)

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.

Illustrate the answers wherever necessary.

Group—A

Answer any *five* questions. 5×2

1. What will be the central fringe of Newton's rings in reflected light and why ?

2. Two tuning forks of slightly different frequencies are used to produce Lissajous figures. A circular figure is found to appear in every 10 sec. If one tuning fork has the frequency 300 Hz, what is the frequency of the other ?

3. An increase of pressure of 100 KPa causes a certain volume of water decrease by 5×10^{-3} per cent of its original volume. Calculate the speed of sound in water.

4. In what respect does holography differ from ordinary photography.

5. For sodium light (589 nm and 589.6 nm) incident normally on a grating having 100 lines/mm, with width of ruling 2 cm. Calculate 1st order resolving power. Are the D lines resolved in 1st order ?

6. In Melde's experiment, the string vibrates in 5 loops when the tension is T. If T is increased by 0.05 kg, the no. of loops becomes 4. Calculate T.

7. The equation of motion of a particle in the x direction is $x = 4\sin^2(wt - \pi/6)$. Show that the particle is in SHM and find the mean position, the frequency of the oscillation.

8. In case of a light two wavelengths $\lambda_1 = 600.5$ nm and $\lambda_2 = 600$ nm, find the distance through the movable mirror of Michelson's interferometer be moved so as to obtain two consecutive positions of maximum distinctness.

Group—B

Answer any *four* questions. 4×5

9. What do you mean by spatial coherence ? From the concept of spatial coherence and with the help young's double slit experiment, find the condition of the linear dimension of the source for good interference fringes. 1+4

10. What is a Zone plate ? Explain its action as a convex lens. Derive an expression for its focal length. 1+2+2

11. (a) Derive a relationship between the group velocity and the phase velocity.

(b) For gravity waves in a liquid, the phase velocity is given by $v_p = C/\sqrt{\lambda}$. Show that the group velocity is half of phase velocity. 3+2

12. A plane progressive harmonic wave propagating along positive x direction is represented by $y = A\cos(wt - kx)$, where the notations have their usual significance.

(a) Find the particle velocity, dialation and the acoustic pressure.

(b) Show that the acoustic intensity is the product of the rms acoustic pressure and the rms particle velocity. 3+2

13. Fraunhofer double slit diffraction pattern is observed in the focal plane of a lens of focal length 0.5 m. The wavelength of incident light is 500 nm. The distance between two maxima adjacent to the maximum of zero order is 5 mm and the fourth order maximum is missing. Find the width of each slit and the distance between their centers. 5

14. Find the nature of the Lissajous figure by the superposition of two simple harmonic motions at right angles when the periods are the same but the amplitudes and the initial phases are different. Hence find the conditions for getting uniform circular motion. 4+1

Group—C

Answer any *one* question. 1×10

15. (a) For stationary waves produced in a stretched string