SET B

Unique Paper Code	: **42224412_OC**
Name of Paper	: **Waves and Optics**
Name of Course	: **B.Sc. (Prog.)_CBCS (Old Course)**
Semester	: **IV**

Duration: **3 Hours**   Maximum Marks: **75**

Answer any **four** questions. All questions carry equal marks.

1. (a) Explain what happens when two oscillations of slightly different frequencies are superposed at a point. Using diagram, show how the waveform of the resultant is related to the component waves.

   (b) Show that two harmonic oscillations, at right angles to each other, of equal amplitudes and equal frequencies but with phase difference of $\pi/2$, are equivalent to a uniform circular motion, the radius of circle being equal to the amplitude of either oscillation.

   (c) Derive the differential equation for the transverse vibration of a uniform flexible string. Obtain an expression for the frequencies of the normal modes of the string which is rigidly fixed at the ends $x = 0$ and $x = l$.   (8.75+7+3)

2. (a) A transverse harmonic wave of amplitude $0.01\ cm$ is generated at one end ($x = 0$) of a long horizontal string by a tuning fork of frequency $500\ Hz$. At a given instant of time the displacement of the particle at $x = 0.1m$ is $-0.005m$ and that of the particle at $x = 0.2m$ is $+0.005m$. Calculate the wavelength and the wave velocity. Obtain the equation of the wave assuming that the wave is travelling along the $+x$ direction and that the end $x = 0$ is at the equilibrium position at time $t = 0$.

   (b) What do you understand by the intensity of sound? Are intensity and loudness the same? How are these quantities measured?

   (c) Two open pipes of lengths $100\ cm$ and $105\ cm$ produce 5 beats in 6 seconds when each is sounding its fundamental note. Calculate the frequencies of the two notes.   (10.75+5+3)

3. (a) Show that in Young's double slit experiment, the fringe width is directly proportional to the wavelength of light.

(b) Explain the meaning of lateral shift in Fresnel's biprism experiment. How do you measure it? How can the wavelength of light be determined by using the biprism?

(c) Explain the Huygens' principle of wave propagation. How the absence of the backward wavefront was explained on the basis of Stoke's law? (6.75+7+5)

4. (a) Give necessary theory of Newton's rings method for determining the refractive index of a liquid and derive the expression used. Why is there a dark spot at the centre of Newton's rings?

(b) Explain how visibility of fringes can be used to check whether a source of light is monochromatic or composite?

(c) How far must the movable mirror of the Michelson interferometer be moved so that 1800 fringes of He-Ne laser light ($\lambda = 633\ nm$) move across a line in the field of view?

(8.75+7+3)

5. (a) With the help of appropriate diagram, explain the difference between the intensity distribution in Fraunhofer diffraction due to single slit and double slit.

(b) What is meant by overlapping and absent spectra obtained in a plane transmission grating?

(c) Monochromatic light from a helium-neon laser ($\lambda = 632.8\ nm$) is incident normally on a diffraction grating containing 6000 grooves per centimeter. Find the angles at which the first and second order maxima are observed. (9.75+6+3)

6. (a) What is a zone plate? Explain how it acts like a converging lens having multiple foci.

(b) In an experiment for observing diffraction pattern due to a straight edge the distance between the source slit of wavelength 5900 Å and and the straight edge is $6\ cm$ and that between the straight edge and eye-piece is $4\ cm$. Calculate the position of the first maxima.

(c) Discuss how the plane polarized light is produced and detected?

(10.75+5+3)