2023
B.A./B.Sc.
Second Semester
CORE – 4
PHYSICS
Course Code: PHC 2.21
(Waves & Optics)

Total Mark: 70   *Pass Mark: 28*
Time: 3 hours

Answer <u>five</u> questions, taking <u>one</u> from each unit.

UNIT–I

1. (a) Derive the wave equation of a progressive harmonic wave.   4
   (b) Show that total energy intensity of the progressive wave is independent of space and time coordinates.   4
   (c) What are water waves? Distinguish between ripple waves and gravity waves.   1+2=3
   (d) A particle performs simple harmonic motion given by the equation $y = 30\sin(\omega t + \theta)$. If the time period is 30 seconds and the particle has a displacement of 10 cm at $t = 0$. Find the phase angle at $t = 5$ seconds.   3

2. (a) What do you mean by wave motion? Derive an expression for velocity of transverse waves in a stretched string.   2+3=5
   (b) Obtain a differential equation for a plane progressive wave.   4
   (c) What is the speed of transverse wave in a rope of length 100 cm and mass 0.6 kg under the tension of 1000 N?   3
   (d) Distinguish between transverse and longitudinal waves.   2

UNIT–II

3. (a) Find the resultant of two simple harmonic motion travelling along the same straight line having the same frequency but different phases and amplitudes.   4

(b) Discuss the formation of Lissajous figure when the two simple harmonic motions are having frequency in the ratio 1:2. What will happen to resultant when phase difference is 90 degree?

$$5+2=7$$

(c) The superposition of two waves produces stationary waves

$$y_1 = 0.05 \sin(3\pi t - 2x)$$
$$y_2 = 0.05 \sin(3\pi t + 2x)$$

where x and y are measured in metre and t is in seconds. Find the amplitude of a particle at $x = 0.5$ m.　　　　3

4. (a) A particle is subjected simultaneously to two SHM of the same period but different amplitude and phases in perpendicular direction. Find the expression for the resultant motion. For what condition the path may be ellipse and straight line.　　　$5+2+2=9$

(b) State the superposition principle in two collinear oscillation.　　2

(c) The equation of a transverse wave on a stretched string is
$y = 2 \sin \pi(8t - 0.005x - 0.40)$. Write down the equation of a wave that would produce a stationary wave in the string on superposition with the given wave.　　　3

UNIT–III

5. (a) Discuss the formation of stationary waves in a string of fixed length.

　　6

(b) Distinguish between dispersive and non-dispersive medium.　　4

(c) An organ pipe of length 2 m open at both ends is found to vibrate in its first harmonic when sounded with a tuning fork of 512 Hz. What should be the length of a pipe closed at one end so that it also vibrates in its first harmonic with the same tuning fork.　　4

6. (a) Give the description of electrically maintaining tuning fork for the transverse and longitudinal waves.　　6

(b) What are normal and anomalous dispersion?　　4

(c) An open organ pipe has a fundamental frequency of 300 Hz. The third harmonic of a closed organ pipe has the same frequency as the second harmonic of the open pipe . What is the length of the open organ pipe? Given that speed of sound in air is 340 m/s.　　4

UNIT–IV

7. (a) Explain the formation of interference fringes in wedge shaped film. Obtain the condition for bright and dark fringes.   4+3+3=10
   (b) Obtain the condition for constructive and destructive interference.   4

8. (a) Explain the formation of interference in biprism. Obtain the condition for bright and dark fringes.   4+3 =7
   (b) Using Stoke's law, show that a phase change of 180° occurs after reflection from the surface of a denser medium.   5
   (c) Distinguish between Michelson and Fabry Perot interferometer.   2

UNIT–V

9. (a) Obtain the expression for dispersive power of a diffracting grating. 7
   (b) Derive an expression for the resolving power of a telescope and find its relation with the magnifying power.   5+2=7

10. (a) Discuss the phenomenon of diffraction at a straight edge. Obtain the condition for bright and dark fringes.   5+5=10
    (b) What is the basic difference between a conventional photograph and a hologram?   2+2=4

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