

2022
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 five questions, taking one from each unit.

UNIT-I

1. (a) Discuss the production of beats and find the expression of beats frequency which is equal to the difference of frequencies of the component oscillation. 6
 - (b) Obtain the resultant motion of two simple harmonic motions travelling along the same straight line having the same frequency but different phases and amplitudes. 6
 - (c) A note produces 3 beats per second with a tuning fork of frequency 514 and 5 beats per second with a tuning fork of frequency 516. Find the frequency of the note. 2
2. What are Lissajous figure? Obtain the nature of the path when two simple harmonic motion acting simultaneously on a particle at right angle to each other have the same periods but different amplitudes and initial phase. Hence discuss the conditions when the phase difference is

$$0, \frac{\pi}{4}, \frac{\pi}{2}, \pi.$$

$$1+5+2+2+2+2=14$$

UNIT-II

3. (a) Derive the expression of transverse wave equation in a string along the positive x -axis direction. 5

- (b) Explain the energy in a progressive wave and intensity of waves. 5
- (c) What is the velocity of a transverse wave along a wire of 1000 metre having a weight of 3 kgf and is pulled by a force of 190 N? 2
- (d) Distinguish between the particle velocity and wave velocity. 2
4. (a) Derive the expression for the velocity of longitudinal wave of a fluid in a cylindrical tube. 6
- (b) Describe Newton's formula for determination of velocity of sound in a gaseous medium. Hence, discuss the Laplace's correction. 6
- (c) What is the speed of transverse wave in a rope of length 1 m and mass 60 g under a tension of 1000 N? 2

UNIT-III

5. (a) Discuss analytically the formation of standing waves in a closed organ pipe. Hence, obtain an expression for the corresponding modes of frequency. 6
- (b) With proper diagram discuss Melde's experiment for the study of transverse and longitudinal waves. 6
- (c) Distinguish between a standing wave and a progressive wave. 2
6. (a) Discuss analytically the formation of standing waves in a string of fixed length. Hence, obtain an expression for the corresponding modes of frequency. 6
- (b) Derive an expression for the group velocity by the superposition of two sinusoidal waves with a wave motion. 5
- (c) What are the various velocities associated with a wave motion? 3

UNIT-IV

7. (a) Give a condition for sustained interference of light waves. 2
- (b) Find an expression for fringe width in case of Young's double slit experiment. 3
- (c) Discuss the interference in the thin film due to reflected and transmitted light waves. 6
- (d) A parallel beam of light of wavelength 5890 \AA is incident on a glass

plate having refractive index 1.5 such that the angle of refraction in the plate is 60° . Calculate the small thickness of glass plate which will appear dark by reflected light. 3

8. (a) What are Haidinger fringes? Explain their formation. 1+3=4
(b) Discuss the formation of Newton's rings by reflected light. Why are Newton's rings circular? Show that the radii of the dark rings are proportional to the square root of the natural numbers. 3+2+2=7
(c) How will you measure the difference in the wavelength of the two waves with Michelson's interferometer? 3

UNIT-V

9. (a) Obtain the radius and area of the Fresnel half period zones in the diffraction of light waves. 6
(b) Give the theory of zone plate in the diffraction of light waves. 6
(c) How many half period elements are there in a circular portion of $1/100$ metre radius of a plane wave front given that the wavelength is 6×10^{-7} m and the distance of the point of observation of the wavelength is 1 m. 2
10. (a) With a proper ray diagram, explain Fraunhofer diffraction pattern of light waves for the condition of maxima and minima position due to a single slit. 2+5=7
(b) What is the fundamental principle of recording a hologram? Explain the recording of hologram of a point object. 2+5=7
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