

**2024/FYUG/ODD/SEM/
PHYDSC-201T/057**

FYUG Odd Semester Exam., 2024

**PHYSICS
(3rd Semester)**

Course No. : PHYDSC-201T

(Waves and Optics)

Full Marks : 70

Pass Marks : 28

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

UNIT—I

1. Answer any *two* from the following : $2 \times 2 = 4$
- (a) Explain the principle of superposition of waves.
 - (b) Write two applications of Lissajous figures.
 - (c) Check whether $y = x^2 - vt^2$ is a solution of one-dimensional wave equation.

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(2)

2. Answer either (a) and (b) or (c) and (d) : 10
- (a) Obtain the resultant amplitude of two SHMs having equal frequencies and travelling in the same direction. 5
- (b) What are beats? Derive the expression for beat frequency. 5
- (c) A particle subjected simultaneously to two SHMs of same time period but of different amplitudes and phases in perpendicular directions. Find the expression for resultant motion. 5
- (d) Obtain the equation when the path of Lissajous curve becomes straight line and circular. 5

UNIT—II

3. Answer any two from the following : 2×2=4
- (a) What are transverse waves and longitudinal waves?
- (b) What do you mean by standing waves? Give one example.
- (c) Define phase velocity and group velocity.
4. Answer either (a) and (b) or (c) and (d) : 10
- (a) Show that the velocity of a plane progressive wave in a string is given by
- $$V = \sqrt{\frac{T}{\rho}}$$
- where T = tension and ρ = linear density of the string. 5

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(3)

- (b) Derive Newton's formula for velocity of sound. What was its limitation? How did Laplace make the correction? 5
- (c) Explain analytically the formation of standing wave in a string fixed at both ends. Hence show how odd and even harmonics are present in such case. 5
- (d) Derive the relation between phase velocity and group velocity. 5

UNIT—III

5. Answer any two from the following : 2×2=4
- (a) Explain Huygens principle of wave front reconstruction.
- (b) What are the two ways of producing interference? Give one example of each.
- (c) What are the conditions of sustained interference?
6. Answer either (a) and (b) or (c) and (d) : 10
- (a) Describe Fresnel's method of biprism for obtaining interference. 5
- (b) How would you determine the wavelength of light with Lloyd's mirror experiment? 5

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(4)

- (c) What is Stokes' law for the phase change of reflection? Show that a phase change of π occurs when reflection takes place at the surface of a denser medium. $1+4=5$
- (d) Explain the formation of Newton's ring by monochromatic light. 5

UNIT—IV

7. Answer any two from the following : $2 \times 2 = 4$
- (a) Explain visibility of fringes.
- (b) Differentiate between Fresnel's diffraction and Fraunhofer's diffraction.
- (c) What do you mean by resolving power of an optical instrument? Write the formula for resolving power of a diffraction grating.
8. Answer either (a) or (b) : 10
- (a) What is the principle of Michelson's interferometer for formation of fringes? Explain how Michelson's interferometer be used to determine wavelength of the source. If the movable mirror in Michelson's interferometer is shifted through 0.0575 mm parallel to itself; 180 number of fringes are found to shift pass a reference mark. Find the wavelength of light used. $2+5+3=10$

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(5)

- (b) Discuss the theory of a diffraction grating to explain how you would use it to determine the wavelength of light. Using relevant formula, explain how the resolving power of a grating is different from resolving power of a telescope. $7+3=10$

UNIT—V

9. Answer any two from the following : $2 \times 2 = 4$
- (a) What are Fresnel's half period zones?
- (b) What is a zone plate? What are two types of zone plate?
- (c) Distinguish between a convex lens and a zone plate.
10. Answer either (a) or (b) : 10
- (a) Describe the theory of zone plate. Determine the radius of the first period zone of focal length 20 cm for incident light of wavelength 5000 angstrom. $7+3=10$
- (b) What types of information of the object recorded in a hologram? Distinguish between a conventional photograph and a hologram. Explain how recording and reconstruction of hologram of an object is done using a beam of laser light. $1+3+6=10$

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