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1 (Sem-3/FYUGP) PHY41 MJ

2025

PHYSICS

(Major)

Paper : PHY4300104 MJ

(Waves and Optics)

Full Marks : 45

Time : 2 hours

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

1. Answer the following questions: $1 \times 5 = 5$

(a) "There is loss of energy in interference of light." It -

(A) is true

(B) is false

(C) may be true

(D) none of the above

(b) In which of the following phenomena the division of wave front phenomenon is applied ?

- (A) Fresnel's biprism
- (B) Newton's ring
- (C) Michelson interferometer
- (D) Thin film

(c) The dispersive power of a grating in diffraction is

- (A) Directly proportional to the order of the spectrum
- (B) Inversely proportional to the order of the spectrum
- (C) Directly proportional to the square root of the spectrum
- (D) Inversely proportional to the square root of the spectrum

(d) Principal of superposition is applicable only for oscillations

- (A) Who govern exponential equation of motion
- (B) Complex equation of motion

(C) Linear equation of motion

(D) None of the above

(e) The velocity of sound in a gas is

- (A) Proportional to its density
- (B) Inversely proportional to its density
- (C) Inversely proportional to the square of root of its density
- (D) Inversely proportional to the square of its density

2. Answer the following equations : **(Any five)**

$$2 \times 5 = 10$$

- (A) What is the principal of superposition of harmonic oscillations ?
- (B) Compare between progressive and stationary waves.
- (C) Define constructive and destructive interference.

- (D) State the factors that affect the velocity of sound in a gas.
- (E) Write the laws of length and tension of transverse vibration in a stressed string.
- (F) Two strings are joined together and stretched with a certain force. If the linear mass density of the second string is four times that of the first string, then calculate ratio of wave velocity in two strings.
- (G) State Huygen's principal of wave theory of light.
- (H) What is wavefront? Write the name of different types of wavefronts.
- (I) How coherent sources of light waves are produced?
- (J) What is a plane diffraction grating? Resolving power of plane diffraction grating depends on which factors.



3. Answer the following questions : **(any four)**

$$5 \times 4 = 20$$

- (A) Find out the expression of resultant displacement for superposition of two oscillations having equal frequencies. If the two oscillations are in same phase, what will be the resultant displacement ? $4+1=5$
- (B) Write the differential equation of S.H.M and solve it. $1+4=5$
- (C) Write about half wave plate and quarter wave plate.
- (D) Define phase velocity and group velocity. Find out the relation between phase velocity and group velocity. $2+3=5$
- (E) Discuss the phenomenon of Fraunhofer diffraction at a single slit. Find the expression for the width of the central maximum.
- (F) What do you mean by plane -polarized, circularly polarized and elliptically-polarized light? Mention how these three types of light can be produced.

$$3+2=5$$

(G) In a Fraunhofer diffraction light a wavelength $6000 \text{ \AA}$ passes through a narrow circular aperture of radius 0.9 mm . At what distance along the axis will the first maximum intensity be observed? Assume focal length of focusing lens to be 20 cm .

(H) Newton's rings are formed by reflection of light of wavelength 600 nm . The diameter of 10^{th} dark ring is 0.4 cm . Calculate the radius of curvature of the lens used.

(I) Write short notes : **(any one)**

(1) Zone plate

(2) Resolving power of a grating.

4. Answer **only one** : $10 \times 1 = 10$

(A) Describe the working principle of a Michelson's interferometer. Discuss how you would determine the separation of two close spectral lines with the help of a Michelson interferometer.

(B) Derive the Newton's formula of velocity of sound in air and discuss Laplace's correction.

(C) What do you mean by progressive waves? Derive the equation of a progressive wave.

(D) What are Lissajous figures? How will you trace graphically the Lissajous figures when (i) the periods are equal and phase difference is $\pi/4$ and (ii) the periods are in the ratio of 2:1 and phase difference is zero.