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 : 1×5=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)*** 2×5=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)*** 5×4=20

(A) Find out the expression of resultant displacement for superposition of two oscillations having equal frequencies. If the two osciliations 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 Fraunhoffer diffraction light a wavelength 6000 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***: 10×1=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) Derived the Newton's formula of velocity of sound in air and discuss Laplace's correction.

(C) What do you mean by progressive waves? Derived 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.
