3068

Unique Paper Code	:	2224001004
Name of the Paper	:	Waves & Optics (GE paper)
Name of the Course	:	B.Sc. Hons.-(Physics)_NEP: UGCF-2022
Semester	:	/ III /
Duration	:	3hours
Maximum Marks	:	90Marks

Instructions for Candidates:

1. **Write your Roll No on the top immediately on receipt of this question paper.**
2. **Attempt 5 questions in all. All questions carry equal marks.**
3. **Q-1 is compulsory.**
4. **Use of Non-programmable scientific calculator is allowed.**

Q-1 Attempt any 6 parts (3X6)

(a) What is Simple Harmonic Motion? What are its characteristics?

(b) Write the expression for the total energy of a mass-spring system undergoing simple harmonic oscillations. Draw graphs of the total, kinetic and potential energies of the oscillator as functions of its position.

(c) State the basic requirements to obtain a sustained interference pattern.

(d) State Huygens's principle of wave propagation. Show how it can be used to explain the formation of interference fringes in a double slit setup.

(e) Two polarizing plates have polarizing directions parallel so as to transmit maximum intensity of light. Through what angle must either plate be turned if the intensity of the transmitted beam is to drop by one-third.

(f) Find the total width of the central maximum in the Fraunhoffer diffraction pattern produced by a slit of width 0.2 mm on a screen placed at a distance of 3m from the slit. λ of light used is 5000 Å

(g) Write Fresnel's assumptions to explain the diffraction phenomena.

Q-2 (a) For a simple harmonic motion, state and prove that the superposition principle is valid only for a linear equation. (5)

(b) Explain the case of superposition of two collinear oscillations of slightly different frequencies and equal amplitude. Explain the nature of the resultant oscillations. (8)

(c) Find the equation of the resultant vibration due to superposition of two collinear oscillations

given as : $x_1 = \sin(\omega t + \pi/3)$ and $x_2 = 2 \sin \omega t$ (5)

Q-3 (a) Explain the formation of interference fringes by means of a Fresnel's biprism. Derive the expression for the fringe width. How is biprism used to determine the wavelength of a monochromatic source? Draw a diagram showing the biprism arrangement for obtaining interference fringes, and the region where fringes are observed. (10)

(b) Using Stoke's theorem show that the reflected ray suffers a phase change of π radians while travelling from rarer to denser medium (4)

(c) A plano-convex lens having radius of curvature 3m is placed on an optically flat glass plate and is illuminated by a monochromatic light. The diameter of the 8^{th} bright ring in the reflected system is 0.72×10^{-2} m. Calculate the wavelength of the light used. (4)

Q-(4) (a) Explain the formation of standing waves on a stretched string by giving necessary theory. (12)

(b) A string that is stretched between fixed supports separated by 75.0 cm has resonant frequencies of 420 Hz and 315 Hz with no intermediate frequencies. What are (a) the lowest resonant frequency and (b) the wave speed? (6)

Q-5 (a) Discuss the intensity distribution of Fraunhoffer diffraction pattern obtained with a single slit illuminated by a parallel beam of monochromatic light. (10)

(b) Determine the ratio of intensity of the secondary maxima to the intensity of the central maximum? (4)

(c) In an experiment for observing diffraction pattern due to a straight edge, the distance between the source and the straight edge is 6 cm and that between the straight edge and eye-piece is 4 cm. Calculate the position of the first maximum from the geometric shadow of the edge. Take wavelength of light to be 590 nm. (4)

Q-6 (a) Describe any 2 methods of producing plane polarized light with the help of appropriate diagrams. (8)

(b) Two coherent sources whose intensity ratio is 9:4 produce interference fringes. Deduce the ratio of the maximum to the minimum intensity of the fringe system. (4)

(c) What is the frequency for the stationary waves which are produced in a 20 m long stretched string. The stretched string vibrates in 4 equal segments and the wave velocity is 30 m/sec. (6)