3569

Confidential

Unique Paper Code	:	2224001004
Name of the Paper	:	Waves & Optics (GE paper)
Name of the Course	:	B.Sc. Hons.–(Physics)_NEP: UGCF-2022
Semester	:	I
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)Explain the relationship between uniform circular motion and Linear Simple Harmonic Motion.
(b) Define phase velocity. Give its expression. Can it be greater than the velocity of light?
(c) What are coherent sources? Can any two different sources be coherent with each other?
(d) Distinguish between interference due to division of wavefront and division of amplitude.
(e) Explain the method of detecting a plane polarized light.
(f) Distinguish between Fraunhoffer and Fresnel diffraction. The light received from a star in a telescope undergoes what kind of diffraction?
(g) A parallel beam of light of wavelength 6563 Å is incident normally on a 0.385 mm wide slit. A lens with a focal length of 0.5 m is placed just behind the slit. Find the distance from the centre of the principal maximum to (i) the first minimum (ii) the fifth minimum.

Q2 (a) Explain the case of superposition of two perpendicular waves of same frequency (ratio 1:1) and find the general solution analytically. Discuss the cases when phase difference $\phi = 0$ and $\pi/2$ with the help of suitable diagrams. (10)

(b) What are Lissajous' Figures? Using graphical method, draw Lissajous' Figures for the frequency ratio 2:1 with phase difference $\phi = \pi$. (5)

(c)How can Lissajous' Figures be used to determine unknown frequencies? (3)

Q-3 (a) What are Newton's rings? Derive an expression for the diameter of the n^{th} bright ring in Newton's rings interference pattern. How can Newton's rings be used to determine the refractive index of a liquid? (10)

(b) Explain how can a bright centre be obtained in Newton rings (4)

(c) A parallel beam of sodium light (λ=5893 Å) strikes at the film of oil floating on water. When viewed at an angle of 30^0 from the normal, 8^{th} dark band is seen. Determine the thickness of the film. (μ_{oil} = 1.5) (4)

Q4 (a) What are stationary waves? Write their two characteristics. (4)

(b) Derive the equation that describes a standing wave and its normal modes on a string of length L fixed rigidly at ends. (8)

(c) The equation of a stationary wave is

$$y = 10\ cos\frac{\pi x}{6} \sin 30\pi t$$

Find the (i) expressions of travelling waves constituting the above stationary wave (ii) wavelength and frequencies of these waves, and (iii) distance between successive nodes. (6)

Q-5(a) Using the half period zone analysis, describe the Fresnel diffraction pattern formed due to a straight edge and explain the features of intensity distribution in the diffraction pattern. (10)

(b) Calculate the number of diffraction orders that will be visible with a plane transmission grating having 18,000 lines in an inch when illuminated by light of wavelength 6800 Å?(1inch =2.54cm) (4)

(c) Explain the condition for missing orders in spectra of plane transmission grating. (4)

Q-6 (a) State and explain Malus's law. An unpolarized light falls on a polarizing sheet. Show that the intensity of the transmitted plane polarized light is half the intensity of the incident unpolarized light. (8)

(b)Distinguish between the plane of polarization and the plane of vibration. (4)

(c) A string 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)