CHAPTER-10
Wave Optics
ASSIGNMENT-1
1 MARK QUESTIONS

Q1. Two plane monochromatic waves propagating in the same direction with amplitudes A and 2A and differing in phase by $\pi/3$ rad superpose. Calculate the amplitude of the resultant wave.

Q2. Two sources of intensity I and 4I are used in an interference experiment. Find the intensity at points where the waves from two sources superimpose with a phase difference is zero.

Q3. In a Young's double slit experiment, the intensity of light at a point on the screen where the path difference is λ, is k units. Find the intensity at a point where the path difference is $\lambda/4$.

Q4. The intensity at the central maxima in Young's double slit experiment is I_0. Find out the intensity at a point where the path difference is $\lambda/6$.

Q5. Find the ratio of intensities at two points in a screen in Young's double slit experiment, when waves from the two slits have path difference of 0 and $\lambda/4$ [CBSE2003]

Q6. Laser light of wavelength 630nm incident on a pair of slits produces an interference pattern in which the bright fringes are separated by 8.1mm. A second light produces an interference pattern in which the fringes are separated by 7.2mm. Calculate the wavelength of the second light. [CBSE2000,09]

Q7. In Young's experiment, the width of the fringes obtained with light of wavelength 6000Å is 2.0mm. Calculate the fringe width if the entire apparatus is immersed in a liquid medium of refractive index 1.33. [CBSE2003]

Q8. A beam of light consisting of two wavelengths 800nm and 600nm is used to obtain the interference fringes in a Young's double slit experiment on a screen placed 1.4m away. If the two slits are separated by 0.28mm, calculate the least distance from the central bright maximum where the bright fringes of the two wavelengths coincide. [CBSE12,09.]

Q9. In Young's double slit experiment, using light of wavelength 400nm interference fringes of width 'X' are obtained the wavelength of light is increased to 600nm and the separation between the slits is halved. If one wants the observed fringe width on the screen to be the same in the two cases, find the ratio of the distance between the screen and the plane of the interfering sources in the two arrangements.

Q10. A parallel beam of light of 600 nm falls on a narrow slit and the resulting diffraction pattern is observed on a screen 1.2 m away. It is observed that the first minimum is a distance of 3 mm from the centre of a screen. Calculate the width of the slit. [CBSE08]

Q11. A monochromatic light of wavelength 500 nm is incident normally on a single slit of width 0.2 mm to produce a diffraction pattern. Find the angular width of the central maxima obtained on the screen. [CBSE17]

Q12. A slit of width d is illuminated by red light of wavelength 6500Å. For what value of d will the first minimum fall at an angle of diffraction of 30°. [CBSE09]

Q13. When the monochromatic light travels from one medium to another its wavelength changes but the frequency remains the same explain [CBSE 11]

Q14. State any two essential conditions for two light waves to be coherent.

Q15. How is the fringe width of an interference pattern in the young's double slit experiment affected if the two slits are brought close to each other? [CBSE 17]

Q16. How does the angular separation between the fringes in the single slit diffraction experiment changes when the distance of the separation between the slit and screen is doubled. [CBSE 12]

Q17. Name the shape of the wave front originating from a point source.

Q18. State the path difference between two waves of destructive interference.

Q19. What is the effect on the interference fringes in the Young's double slit experiment if the separation between two slits is increased?

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Q20. In a double slit experiment instead of taking slits of equal width, one slit is made twice as wide as other. Then the interference pattern

A) the intensity of both the maxima and the minima increase.

B) the intensity of the Maxima increases and the minimum has zero intensity.

C) the intensity of the maximum decreases and that of minima increases.

D) the intensity of Maxima decreases and the minimum has zero intensity.

Q21. To demonstrate the phenomenon of interference we require

A) two sources which emit radiation of the same frequency

B) two sources which emit radiation of nearly same frequency.

C) two sources which emit radiation of same frequency and have a constant phase difference

D) two sources which emit radiation of different wavelength.

Q22. A double slit experiment is performed with light of wavelength 500 mm a thin film of thickness to new m and refractive index 1.5 is introduced in the path of upper beam the location of the central maximum will

A) remain unshifted.

B) shift downward by 10 fringes.

C) shift downward by nearly two fringes.

D) shift upward by nearly two fringes.

Q23. A monochromatic beam of light is used for the formation of fringes on the screen by illuminating the two slits in the young's double slit interference experiment. When a thin film of mica is in interposed in the path of one of the interfering beams then

A) the fringe width increases.

B) the fringe width decreases.

C) the fringe width remains the same but pattern shifts.

D) the fringe pattern disappears.

Q24. In young's double slit experiment an electron beam is used to obtain the interference pattern if speed of electron is increased then

A) distance between two consecutive fringes will increase.

B) distance between two consecutive fringes will decrease.

C) no interference pattern will be observed.

D) distance between two consecutive fringes remain same.

Q25. Yellow light is used in a single slit diffraction experiment with slit width of 0.6 mm. lf yellow light is replaced by X-rays then the observed pattern will reveal

A) the central maximum is narrower.

B) more number of fringes.

C) less number of fringes.

D no diffraction pattern.

Q26. Maximum diffraction takes place in a given slit for

A) Gamma rays B) UV light C) infrared light D)radio waves

Q27. If I is the intensity of the principal maximum in the single slit diffraction pattern then what will be its intensity when the slit width is doubled?

A) I B) I/2 C) 2I D) 4I

Q28. What happens if one of the slits, say S_1 in Young's double, slit experiment-is covered with a glass plate which absorbs half the intensity of light from it?

A) The bright fringes become less-bright and the dark fringes have a finite light intensity

B) The bright fringes become brighter and the dark fringes become darker

C) The fringe width decreases

D) No fringes will be observed

Q29. What happens to the interference pattern the two slits S_1 and S_2 in Young's double experiment are illuminated by two independent but identical sources?

A) The intensity of the bright fringes doubled

B) The intensity of the bright fringes becomes four times

C) Two sets of interference fringes overlap

D) No interference pattern is observed

2 MARKS QUESTIONS

Q30. How does the width of interference fringes in young's double slit experiment change when?

i)The distance between the slit and the screen is decreased

ii)The frequency of the source is increased.

Q31. In young's double slit experiment, the two slits 0.15 mm apart are illuminated by a monochromatic light of wavelength 450 nm. The screen is 1m away from the slits.

a) Find the distance of the second (i) bright fringe(ii) dark fringe from the central maximum

b) How will the fringe pattern change if the screen is moved away from the slits? [CBSE 2010]

Q32. Why cannot two independent monochromatic sources produce sustained interference pattern? [CBSE 2015,19]

Q33. Does the appearance of bright and dark fringes in the interference pattern violate, in anyway, conservation of energy? Explain.

Q34. Why is no interference pattern observed when two coherent sources are

(i) infinitely closed to each other?

(ii) far apart from each other? [CBSE 2008]

Q35. What changes in the interference pattern in young's double slit experiment will be observed when?

(i) the apparatus is immersed in water?

(ii) light of smaller frequency is used? [CBSE 2004,09]

Q36. Laser light of wavelength 630 nm on appear of slits produces and interference pattern in which the bright fringes are separated by 8.1 mm. A second light produces and interference pattern in which fringes are separated by 7.2 mm. Calculate the wavelength of the second light

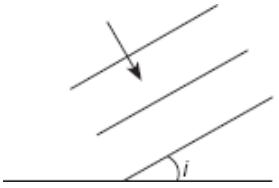
Q37. Yellow light of wavelength 6000A produces fringes of width 0.8 mm in young's double slit experiment. What will be the fringe width if the light source is replaced by another monochromatic source of wavelength 7500 A and the separation between the slits is doubled?

Q38. The light waves from two coherent sources have intensity in the ratio 4 : 9. Find the ratio of intensity of maxima and minima in the interference pattern. [CBSE 2017]

Q39. The ratio of intensity is at maxima and minima is 25:16. What will be the ratio of width of two slits in young's double slit experiment? [CBSE 2006]

3 MARKS QUESTIONS

Q40. A plane wavefront propagating in a medium of refractive index μ_1 is incident on a plane surface making the angle of incidence ***i*** as shown in the figure. It enters into a medium of refractive index μ_2 ($\mu_2 > \mu_1$). Use Huygens'



construction of secondary wavelets to trace the propagation of the refracted wavefront. Hence verify Snell's law of refraction.

Q41. How is a wavefront defined? Using Huygens's construction draw a figure showing the propagation of a plane wave reflecting at the interface of the two media. Show that the angle of incidence is equal to the angle of reflection.

Q42. Why cannot two independent monochromatic sources produce sustained interference patterns? Deduce, with the help of Young's arrangement to produce interference pattern, an expression for the fringe width.

Q43. The intensity at the central maxima (O) in a Young's double slit experiment is $\boldsymbol{I_o}$. If the distance OP equals one-third of the fringe width of the pattern, show that the intensity at point P would be $\frac{I0}{4}$.

Q44. How is Huygens's principle used to obtain the diffraction pattern due to a single slit? Show the plot of variation of intensity with angle and state the reason for the reduction in intensity of secondary maxima compared to central maximum.

Q45. In a double slit interference experiment, the two coherent beams have slightly different intensities I and $I + \delta I$ ($\delta I << I$). Show that the resultant intensity at the maxima is nearly $4I$ while that at the minima is nearly $\frac{|\delta I|^2}{4I}$.

Q46. In a single slit diffraction pattern, how does the angular width of central maximum change, when (i) width of slit is decreased (ii)distance between slit and screen is increased (iii) light of smaller visible wavelength is used?

Q47. Light of wavelength 550 nm is incident as parallel beam on a slit of width 0.1 mm. Find the angular width and the linear width of the principal maxima in the resulting diffraction pattern on a screen kept at a distance of 1.1 m from the slit, which of these width would not change if the screen were moved to a distance of 2.2 m from the slit?

Q48. What is diffraction of light? Differentiate between diffraction and interference.

Q49. Yellow light (λ = 6000 Å) illuminates a single slit of width 1 x 10^{-4}m. Calculate the distance between two dark lines on either side of central maximum when the diffraction pattern is viewed on a screen kept 1.5 m away from the slit.

5 MARKS QUESTIONS

Q50. (a) State Huygens's principle. Using this principle draw a diagram to show how a plane wavefront incident at the interface of the two media gets refracted when it propagates from rarer to a denser medium. Hence verify Snell's law of refraction.

(b) When monochromatic light travels from a rarer to a denser medium, explain the following,giving reasons:

(i) Is the frequency of reflected and refracted light same as the frequency of incident light?

(ii) Does the decrease in speed imply a reduction in the energy carried by light wave?

Q51. (a) (i) 'Two independent monochromatic sources of light cannot produce a sustained interference pattern'. Give reason.

(ii) Light waves each of amplitude a and frequency *n*, emanating from two coherent light sources superpose at a point. If the displacements due to these waves is given by $y_1 = a \cos t$ and $y_2 = a \cos(\omega t + \phi)$, what is the phase difference between the two, obtain the expression for the resultant intensity at the point.

(b) In Young's double slit experiment, using monochromatic light of wavelength, the intensity oflight at a point on the screen where path difference is, is *K* units. Find out the intensity of light at a point where path difference is $\frac{\lambda}{3}$.

Q52. (a) In Young's double slit experiment, describe briefly how bright and dark fringes are obtained on the screen kept in front of a double slit. Hence obtain the expression for the fringe width.

(b) The ratio of the intensities at minima to the maxima in the Young's double slit experiment is 9 : 25. Find the ratio of the widths of the two slits.