U.G. 2nd Semester Examinations 2022
PHYSICS (Honours)
Paper Code : DC-4T
(Waves and Optics)

Full Marks : 25   Time : Two Hours

The figures in the margin indicate full marks.
Candidates are required to give their answers
in their own words as far as practicable.

1. Answer any *five* questions :   2×5=10

   (a) Calculate the group velocity when two waves

   $$y_1 = 10 \sin\left(3\pi t - 6x\right)$$
   $$y_2 = 15 \sin\left(6\pi t + 6x\right)$$

   superimpose, y_1 and y_2 are in metres.

   (b) A slit of width 'a' is illuminated by red light of wavelength 6500 Å. For what value of 'a', we would observe first minima, if the angle of diffraction is 30°?

   (c) In a Newton's ring experiment, the radii of nth and $(n+5)^{th}$ rings are 4 mm and 6 mm, respectively. If the radius of curvature of the plano-convex lens is 1.0 meter, find the wavelength of the light used.

   (d) A viewing screen is separated from double-slit source by 1.2 meter. The distance between the two slits is 0.030 mm. The second order bright fringe is found at a distance 4.5 cm away from the central fringe. Determine the wavelength of the light.

   (e) A zone-plate brings a parallel beam of light of wavelength 600 nm to the first focus at a distance 2 m. Calculate the radius of the central element of the zone-plate.

   (f) Find the minimum number of lines in a grating which can just resolve the 3rd order spectrum of two lines having wavelengths 5890 Å and 5896 Å.

[P.T.O.]

(g) A stretched string of length 50 cm vibrates at the fundamental note of frequency 30 Hz. If the mass of the string is 30 gm, find the velocity of propagation of the transverse wave and compute the tension of the string.

2. Answer any *three* questions :   5×3=15

(a) Derive a mathematical expression for Lissajous figure of two SHMs of same frequency having amplitude a_1 and a_2 and of phase difference ϕ act at right angle to each other. What will be the nature of Lissajous figure when $\phi = \frac{\pi}{2}$?   3½+1½

(b) Discuss the Fraunhoffer diffraction in a single slit. Find the position of the maxima and minima.   3+2

(c) Derive the expression for the condition of the maxima and minima for reflected light in case of thin transparent film of uniform thickness, when a monochromatic light is used. What will be observed if white light is used in this case?   5

(d) Explain the basic principles of holography. How can one prepare a hologram by the process of optical analysis?   3+2

(e) State the principle of a Febry-Perot interferometer. Why interference fringes obtained in Febry-Perot interferometer are sharper than that of the Michelson interferometer?

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