[This question paper contains 3 printed pages.]

Sr. No. of Question Paper : 946 **E** **Your Roll No.....**

Unique Paper Code : 222402

Name of the Course : **B.Sc. (Hons.) Physics**

Name of the Paper : Optics (PHHT-412)

Semester : IV

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt any **five** questions in all.
3. Use of non-programmable scientific calculators is allowed.

1. Attempt any **five** of the following questions:

   (i) Distinguish between ordinary photography and Holography.

   (ii) Show that the deviation produced by a thin lens is independent of the position of the object.

   (iii) Derive the expression $\mu_1 \sin\theta_1 = \mu_2 \sin\theta_2$ from Fermat's principle of extreme path.

   (iv) Give any three differences between temporal and spatial coherence.

   (v) Why do excessively thin films seen by reflected light appear dark?

   (vi) A plane wave of wavelength 5893 Å passes through a slit 0.5 mm wide and forms a diffraction pattern on a screen placed 1 m away from the slit and parallel to it. Calculate the separation of first dark band on either side of central maximum.

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(vii) Each slit of a double slit has a width of 0.15mm and the distance between their centres is 0.75 mm. Find the missing orders, in the diffraction pattern.

(viii) Compare the diffraction pattern in the case of circular aperture and circular disc. (5×3=15)

2. (a) Show that the focal length of a thick lens is given by:

$$\frac{1}{f} = (\mu - 1)[\frac{1}{R_1} - \frac{1}{R_2} + \frac{\mu - 1}{\mu} \cdot \frac{d}{R_1 R_2}]$$

Here μ is the refractive index of the material of the lens, R_1 and R_2 are the radii of curvature of the lens surfaces and d is the lens thickness along the axis. Discuss how the converging and diverging properties of such lenses vary with thickness. (10)

(b) Two thin convex lenses of focal lengths 20 cm and 5 cm are placed co-axially separated by a distance of 10 cm. Determine the position of the cardinal points for the combination. (5)

3. (a) Describe briefly the Fresnel hi-prism setup to obtain interference fringes. How its fringes are different from that of Liyod's mirror. (10)

(b) A bi-prism is placed 5 cm from a slit illuminated by sodium light (λ = 5890 Å). The width of the fringes obtained on a screen 75 cm from the bi-prism are 9.424×10^{-2} cm. What is the distance between the two coherent sources? (5)

4. (a) What do you mean by division of wavefront and division of amplitude? Derive an expression for the path difference indroduced by a parallel thin film for reflected rays. (10)

(b) What are localized frings? How they are formed in Newton's ring experiment? (5)

5. (a) Explain the formation of fringes in Michelson's Interferometer. How are these circular fringes different from those obtained in the Newton's Ring experiment? (10)

   (b) Explain the determination of difference in wavelength of two waves using Michelson's Interferometer (5)

6. (a) Give the theory of Plane transmission grating and hence deduce the grating equation. Also explain the location of interference maximas and minimas. (10)

   (b) Derive an expression for the resolving power of plane transmission grating. (5)

7. (a) Derive Fresenel's integrals and state their properties. (10)

   (b) Discuss the theory of zone plate and show that it has multiple foci. (5)