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Roll No. | | | | | | | | | | |

S. No. of Question Paper : **1590**

Unique Paper Code : **222402** **C**

Name of the Paper : **Optics (PHHT-412)**

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

Semester : **IV**

Duration : **3 Hours** Maximum Marks : **75**

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt any *Five* questions.

Question No. **1** is compulsory.

Use of non-programmable scientific calculator is allowed.

1. Attempt any *five* of the following questions : 5×3=15

(*i*) Why an extended source is required to observe interference pattern in a thin film ?

(*ii*) In a Fresnel bi-prism experiment the fringe-width observed is β ? What will be its value if the slit to the bi-prism distance is reduced to half the original distance ? (All else remaining constant).

(*iii*) Differentiate between Haidinger and Fizeau fringes.

(*iv*) How a non-reflecting coating is made ? What is the principle involved in the process ?

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(*v*) How grating spectra is different from the prism spectra ?

(*vi*) Give *two* important differences between interference fringe pattern obtained by Lloyd's mirror and bi-prism method.

2. (*a*) State and explain the principle that unifies the rectilinear propagation of light, the laws of reflection and refraction. 3

(*b*) Using this principle, obtain a relation between object distance (u) and image distance (v) in terms of radius of curvature (r) of spherical convex surface separating two media of refractive indices μ_1 and μ_2 i.e.

$$\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{r}.$$

Mention the important approximations taken in the above derivation. 8

(*c*) A luminous monochromatic point source is placed in air 30 cm away from a convex surface separating air from glass (refractive index = 1.52). If image is formed at a point 20 cm inside glass, find the radius of curvature. 4

3. (*a*) Describe Stokes treatment of reflection and refraction of waves from a transparent dielectric medium. 5

(*b*) Describe how you would use Newton's rings to measure the wavelength of light and refractive index of a transparent liquid. Give an outline of the necessary theory. 10

4. (*a*) Explain the standardisation of a metre using Michelson's Interferometer. 10

(*b*) In an experiment for determining the refractive index of gas using Michelson's Interferometer a shift of 148 fringes is observed, when all the gas is removed from the tube. If the wavelength of light used is 589.3 nm and length of the tube is 20 cm, calculate the refractive index of the gas. 5

5. (*a*) What are achromatic fringes ? Discuss the experimental arrangement for obtaining these fringes. Draw the necessary diagram. 8

(*b*) What do you mean by purity of spectral line ? How is it related to coherence time ? 4

(*c*) Obtain the ratio of coherence lengths of two laser sources having frequency widths 2×10^2 Hz and 3×10^2 Hz. 3

6. (*a*) What is meant by half period zones ? Explain the approximate rectilinear propagation of light on the basis of half-period zones. 5

(*b*) Give the necessary theory of a zone plate explaining multi-image formation by it. 7

(*c*) For light of wavelength $\lambda = 5893$ Å and radius of first half period zone is 6×10^{-4} m. a zone plate bringing rays to focus at the brightest spot. Find the focal length of equivalent lens. 3

7. (*a*) Discuss the Fraunhoffer diffraction due to plane transmission grating. Explain what are missing spectra in a grating. 8

(*b*) How many orders of diffraction will be visible in a transmission grating having 18,000 lines in an inch (2.54 cm) when illuminated normally by light of wavelength 6800 Å. 3

(*c*) Bi-chromatic light of wavelength 5890 A and 5896 Å is allowed to fall on a plane tranmission grating. Calculate the minimum number of lines the grating should have to be able to resolve the doublet in the first order. 4