WEST BENGAL STATE UNIVERSITY

B.Sc. Honours PART-II Examinations, 2016

PHYSICS-HONOURS

PAPER-PHSA-IV-A

Time Allotted: 2 Hours | Full Marks: 50

The figures in the margin indicate full marks. Candidates should answer in their own words and adhere to the word limit as practicable.

Answer Question. No. 1 and any *four* questions from the rest, taking at least *one* from each group.

1. Answer any *five* questions from the following: $2 \times 5 = 10$

(a) What do you mean by chromatic aberration of a lens?

(b) What do you mean by interference produced due to the division of wavefront and due to the division of amplitude? Give examples.

(c) What are the important practical applications of Michelson Interferometer?

(d) Why is it necessary to use narrow source for biprism and extended source for Newton's ring?

(e) On what factors does the specific rotation of an optically active substance depend?

(f) Find the missing orders of a double slit Fraunhoffer diffraction pattern if the slit widths are 0.1mm and they are separated by a distance of 0.8 mm.

(g) A ray of light moves from an initial point A to a final point B by pure translation. Find the translation matrix.

(h) Determine the state of polarization represented by the following equations.

$E_x = E\sin(kz - \omega t)$; $E_y = -E\sin(kz - \omega t)$.

Group-A

2. (a) Construct the translation matrix under the paraxial approximation. Also set up the refraction matrix at a spherical refracting surface separating two homogenous media. 2+3

(b) Consider a plano-convex lens of a material of refractive index 1.5. The convex surface has a radius of curvature of 2.5 cm and is facing the incident light. The centre thickness of the lens is 0.6 cm. Construct the system matrix.

(c) Consider a system of two lenses separated by a distance in air. If p' represents the distance of 1st principal plane from the 1st lens and p represents the distance of 2nd principal plane from 2nd lens, show that $p'f_2 + pf_1 = 0$. 2

3. (a) Define angular dispersion and dispersive power of the material of a prism. 2

(b) Find the condition of acromatism of separated doublet. Comment on the case when the lenses are made of same material and separation between the lenses vanishes. 2+2

(c) Find the focal points and the principal points of a Huygen's eyepiece. 4

4. (a) Construct the system matrix and hence find the equivalent focal length, the positions of two principal focal points and the two nodal points for a combination of two convex lenses of focal lengths 20 cm and 10 cm, situated at a distance of 10 cm apart. 3+3

(b) Derive Fermat's principle from the laws of reflection of light at a plane surface. 4

Group-B

5. (a) Explain the term 'coherent sources'. How they are realised in practice? 2+2

(b) The intensity distribution function for a narrow single slit is given by

$$I = I_0 \frac{\sin^2 \alpha}{\alpha^2}, \text{ where } \alpha = \frac{\pi a \sin\theta}{\lambda}.$$

(i) Find the conditions for maxima and minima. 2+2

(ii) From the expression of intensity show that 'most of the incident light is concentrated in the central maxima'. 2

6. (a) What is a Zone plate? Determine an expression for its focal length. 1+3

(b) Give the theory of Newton's ring experiment to determine the wavelength of monochromatic light and show how, from their study the refractive index of a liquid can be determined. 4+2

7. (a) Describe how the rotation of the plane of polarization in an optically active medium is explained?. 2

(b) Let x and y component of the electric vector of an electromagnetic waves are given by 2+2

$E_x = a_1 \sin \omega t$,

$E_y = a_2 \sin(\omega t + \delta)$, where the symbols have their usual significance.

Show that,

(i) For $\delta = 2n\pi$, where $n \in N$, the electromagnetic wave is linearly polarized.

(ii) For $\delta = \left(n + \frac{1}{2}\right)\pi$, where $n \in N$, it is elliptically polarised.

(c) When does the elliptically polarised light become circularly polarised? 2

(d) Determine the state of the emerging light when a beam of elliptically polarised light is passed through a quarterwave plate. 2