WEST BENGAL STATE UNIVERSITY

B.Sc. Honours PART-II Examinations, 2017

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. All symbols are of usual significance.

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: 2×5 = 10

   (a) Define cardinal points of an optical system.

   (b) Determine the refraction matrix when light is incident on a plane surface separating two media having refractive indices n_1 and n_2 respectively.

   (c) Explain why an extremely thin film illuminated by white light appears to be perfectly black when viewed by reflected light.

   (d) What type of aberration is present in lenses and absent in mirrors?

   (e) State the differences between grating spectra and prism spectra.

   (f) What is a zone plate?

   (g) How can you detect circularly polarized light from unpolarized light?

   (h) Calculate the thickness of the quartz halfwave plate for Sodium light of wavelength 5893 Ang. It is given that the index of refraction of quartz for the ordinary and the extraordinary rays are 1.5442 and 1.5533.

Group-A

2. (a) State Fermat's principle and establish the lens makers formula using Fermat's principle. 1+5

   (b) Derive the Helmholtz-Lagrange relation between the two types of magnifications. 4

3. (a) Define and explain what is meant by spherical aberration with a neat diagram. Also define what is meant by circle of least confusion and indicate its location in the diagram. 2+2

   (b) Two thin convex lenses of focal length 0.12 m and 0.06 m are placed co-axially 0.08 m apart. Find the system matrix. Find the position of the cardinal points of the system. 3+3

4. (a) Mention in one or two sentences the reason and the method of removal of the following two types of aberrations in a lens 2+2

   (a) Coma, (b) Chromatic aberration.

   (b) What is an eyepiece? Give the construction and the working principle of a Ramsdens eyepiece and determine its focal length. 1+1+2+2

Group-B

5. (a) Apply Huygens's principle of wave propagation to deduce the laws of reflection of a plane wave from a plane reflecting surface. 4

   (b) Derive the theory for determination of wavelength of monochromatic light with the help of Fresnel's Biprism. 4

   (c) Explain the phenomenon of double refraction. 2

6. (a) The expression for intensity of Fraunhoffer diffraction pattern of N slits is given by 4

$$I(\theta) = I_0 \frac{\sin^2 N\gamma}{\sin^2 \gamma} \frac{\sin^2 \beta}{\beta^2}$$

(i) Find the location and intensity of the principal maxima.

(ii) Show that resolving power of the grating is given by $R = m\,N$.

Symbols have their usual meaning.

(b) Calculate the least width a grating must have to resolve the D-lines of Sodium (589.0 nm and 589.6 nm) in the second order. Given the number of lines per mm of the grating is 80. 3

(c) In a Michelson interferometer, if one of the mirrors is moved through a distance of 0.08 mm 250 fringes across the field of view, calculate the wavelength of the light used. 3

7. (a) State Malu's law. Unpolarized light of intensity I_0 falls normally on a Polaroid. Show that the intensity of the emerging ray of light is $\frac{1}{2} I_0$. 1+1

(b) Describe the construction of a Nicol prism. 3

(c) Explain how plane polarized light can be obtained using Nicol prism. 3

(d) One litre of sugar solution is prepared by dissolving 80 mg of sugar in water. The optical rotation, when placed in a tube of 30 cm, is found to be 13.3°. If the specific rotation of sugar is 62° (in usual units), find the percentage impurity in the sample. 2