WEST BENGAL STATE UNIVERSITY

B.Sc. Honours Part-II Examination, 2020

PHYSICS

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.

Question No. 1 is compulsory. Answer any *two* other questions from the rest

1.   Answer any *ten* questions from the following: $3\times10 = 30$

   (a) Explain the idea of equivalent focal length for a combination of lenses.

   (b) What is meant by paraxial approximation in geometrical optics?

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

   (d) State the conditions under which the principal and nodal points of an optical system coincide.

   (e) It is desired to make a converging achromatic lens of mean focal length 30 cm by using two lenses of materials A and B in contact. If the dispersive powers of A and B are in the ratio 1:2, find the focal length of each lens.

   (f) Why does an eyepiece usually consist of two lenses instead of one?

   (g) Mention main categories of seidal aberration.

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

   (i) Distinguish between temporal coherence and spatial coherence.

   (j) If the widths of slits in Young's double slit experiment, are slightly different instead of being exactly same, will there be any difference in its fringe pattern?

   (k) Why is it necessary to use a narrow source for a biprism experiment and an extended source for a Newton's ring experiment?

   (l) What is meant by Fresnel's class of diffraction?

   (m) When an unpolarized light of intensity I_0 falls normally on a polaroid, show using Malus law that the intensity of the emerging light is $I_0/2$.

   (n) What is Brewster's angle? Mention its significance.

   (o) Mention the physical factors on which the specific rotation of an optically active substance depends.

   (p) What is 'tint of passage'?

2. (a) Using Fermat's principle find the relation between object distance and image distance when a point object is placed before a spherical interface (with radius R) between two media with refractive indices n_1 and n_2 respectively. Hence establish the lens makers formula.   3+2

   (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 thickness at the centre of the lens is 0.6 cm. Construct the system matrix.   3

   (c) Define dispersive power of a prism.   2

3. (a) Find the focal points and the principal points of a Ramsden's eyepiece.   4

   (b) A Ramsden's eyepiece consists of two positive lenses, each of focal length 4 cm and separated by a distance of 3 cm. Find the focal length of the eyepiece and the positions of the principal points.   4

   (c) Discuss the performance of Ramsden's eyepiece as compared to Huygen's eyepiece.   2

4. (a) Compare between interference and diffraction phenomena.   2

   (b) Obtain the expression for intensity of Fraunhofer diffraction pattern for a plane diffraction grating with N slits.   4

   (c) Using Rayleigh criterion of optical resolution, 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 of the spectrum. Given the number of lines per mm of the grating is 80. Derive the requisite formula before the calculation.   4

5. (a) In a Michelson interferometer if one of the mirrors is moved through a distance of 0.08 mm the number of fringes that move across the field of view is 250. Calculate the wavelength of the light used.   3

   (b) What is a half-wave plate? What will happen if a half-wave plate is inserted in the path of an elliptically polarized light?   2+2

   (c) Calculate the thickness of a half-wave plate for sodium light (mean wavelength: 589.3 nm), given $n_0 = 1.54$ and the ratio of the velocities of O-component and E-component is 1.007. Is the crystal positive or negative?   2+1

   N.B. : *Students have to complete submission of their Answer Scripts through E-mail / Whatsapp to their own respective colleges on the same day / date of examination within 1 hour after end of exam. University / College authorities will not be held responsible for wrong submission (at in proper address). Students are strongly advised not to submit multiple copies of the same answer script.*

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