



'সমানো মন্ত্র: সমিতি: সমানী'

**UNIVERSITY OF NORTH BENGAL**

B.Sc. Honours Part-II Examination, 2022

**PHYSICS**

**PAPER-IV**

Time Allotted: 4 Hours

Full Marks: 70

*The figures in the margin indicate full marks.  
All symbols are of usual significance.*

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

1. (a) Show that the distance from a concave mirror must have an object be placed so that its image shall be magnified 'n' times is  $\frac{f(n \pm 1)}{n}$ , where  $f$  is the focal length of the mirror. 3
- (b) Newton's rings are formed by light of 400 nm wavelength. Between the third and sixth bright fringe, what is the change in thickness of the air film? 3
- (c) Explain the role of minority carriers on the barrier potential across a p-n junction. 4

**GROUP-A (Geometrical Optics)**

2. (a) State and explain Fermat's principle. 3
- (b) Apply Fermat's principle to prove the law of refraction in case of a plane surface. 3
- (c) Explain, with diagram, the working principle of a Huygens eyepiece. What are its merits and demerits? 4+2
3. (a) What is distortion? How can distortion be eliminated in optical system? 2
- (b) Find out the cardinal points of two thin lenses separated by a distance in air. 4
- (c) What is angular dispersion? For a thin prism, derive the expression for angular dispersion. 1+2
- (d) What is achromatism? Find the required condition of achromatism for two lenses separated by a distance. 1+2

**GROUP-B (Physical Optics)**

4. (a) What are the nature of sources that produce spherical and cylindrical waves? Write down the expression for wave function for cylindrical waves. 2+1
- (b) Establish from wave theory, the relation 4

$$\frac{n}{v} - \frac{1}{u} = \frac{n-1}{r}$$

for refraction of spherical waves through spherical refracting surface, when the first medium is air. Where symbols have their usual meaning?

- (c) What are Coherent sources? How are Coherent sources produced in case of Lloyd's mirror? 1+2
- (d) Explain the rectilinear propagation of light on the basis of Fresnel's half-period zones. 2
5. (a) Apply Huygen's principle to deduce the laws of refraction of plane waves at plane surface. Hence on the basis of wave theory, explain the phenomena of total internal reflection and obtain the value of critical angle. 3+3
- (b) What do you mean by fringes of equal thickness and fringes of equal inclination? 3
- (c) Show that an extremely thin transparent film transmits the whole of incident light to the other side. 3
6. (a) What are Newton's rings? Derive the relation for the diameter of the bright rings in case of reflected light. Hence, obtain the relation between the fringe width and diameter of the rings. 1+3+2
- (b) What is plane diffraction grating? Obtain an expression for the intensity of a beam diffracted from such a grating when monochromatic light is incident normally upon it. 2+4
7. (a) Obtain the expressions of magnifying power of astronomical telescope for normal vision and distinct vision. 3
- (b) Monochromatic light from a broad source is incident on a Fabry-Perot interferometer: 3+3
- (i) Draw a suitable diagram and show that the formation of Haidinger fringes onto the focal plane of the telescope.
- (ii) Explain how you can use Fabry-Perot interferometer for fine structure analysis of spectral lines.
- (c) Establish a relation between the resolving power and the magnifying power of a microscope. 3

**GROUP-C (Electronics-I)**

8. (a) Draw a circuit diagram of transistor amplifier in CE mode and hence draw its low frequency hybrid equivalent circuit. Hence, derive the expression of (i) Voltage gain (ii) Input impedance (iii) Current gain. 1+2+1  
+1+1
- (b) Explain briefly how zener diode maintain constant voltage across a load. 3
- (c) Explain what do you mean by ideal current source and ideal voltage source? 3
9. (a) Simplify the expression  $X = (A + B)(A + \bar{B})(\bar{A} + B)$  and draw the simplified circuit. 3
- (b) Draw an OR, an AND and a NOT gate using transistors and explain their operation. 2+2+2
- (c) Use 2's Complement method to perform subtraction  $58 - 39$ . 2
- (d) Why a semiconductor acts as an insulator at temperature, 0 K. 1

—x—