Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.OPTM/SEM-1/BO-101/2012-13

2012

GEOMETRICAL OPTICS – (OPTICS-I)

Time Allotted : 3 Hours Full Marks : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following : $10 \times 1 = 10$

i) The refractive index of water with respect to air is

a) 1·30 b) 1·31

c) 1·33 d) 1·32.

ii) The wave theory of light was proposed by

a) Newton b) Planck

c) Huygens d) Brewster.

iii) Velocities of light in diamond, glass and water decrease in which of the following orders ?

a) Water > Glass > Diamond

b) Diamond > Glass > Water

c) Diamond > Water > Glass

d) Water > Diamond > Glass.

iv) When the focal length is infinite, the power will be

a) zero b) infinite

c) 100 d) 10.

v) Convex lens acts like a reading glass, when object is kept

a) at focus

b) at $2F$

c) in between $2F$ and F

d) in between F and optical centre.

vi) Geometrical Optics is also known as

a) Geometry optics b) Co-ordinate optics

c) Ray optics d) Photon optics.

vii) Convex lens is used as slide projector when object is kept

a) at $2F$ b) in between F and $2F$

c) at F d) none of these.

viii) Optical fibre works on the principle of

a) refraction b) total internal reflection

c) reflection d) none of these.

ix) If two thin lenses of powers P_1 and P_2 are kept in contact then equivalent power is

a) $P_1 \times P_2$ b) $P_1 - P_2$

c) $P_1 + P_2$ d) none of these.

x) Total internal reflection occurs when light travels from

a) rarer to denser medium

b) denser to rarer medium

c) both (a) and (b)

d) none of these.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. Define optical fibre. State the uses of optical fibre.

3. Write a short note on cardinal points of thick lens system.

4. What is total internal reflection ? Mention condition of total internal reflection. 2 + 3

5. Write a short note on astigmatism.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

6. What is a lens ? Obtain lens makers' formula. Deduce the formula to find out the equivalent focal length and power when two convex lenses are mounted coaxially to form a combination. 2 + 5 + 8

7. a) Derive vergence equation for refraction at a curved surface.

b) Obtain lens makers' formula for a thin lens. 7 + 8

8. a) For a thin prism prove that $\delta = (\mu - 1)A$, where the symbols have their usual meaning.

   b) An image of size d_1 is formed on a screen by a convex lens. By moving the lens an image of size d_2 is formed when the object and the screen are fixed. Show that the size d of the object is given by

   $$d = (d_1 d_2)^{1/2}.$$

   c) A convex lens of glass ($n = 1{\cdot}5$) has radii of curvature 15 cm and 30 cm. Find its focal length in air. What will be its focal length in water of refractive index 4/3 ?

5 + 5 + 5

9. a) Write the statement of the Fermat's principle.

   b) Prove Snell's law of refraction in the light of Fermat's principle for a plane surface.

   c) For a concave spherical surface find out the vergence equation.

2 + 7 + 6

10. a) Why is matrix method useful in optics ?

    b) Differentiate between the following :

       i) Step index and graded index fibre

       ii) Single mode and multimode fibre.

    c) With sketch define

       i) Critical angle

       ii) Angle of acceptance.

    d) A fibre cable has an acceptance angle of 30° and a core index of refraction of 1·4. Calculate the refractive index of the cladding.

3 + (3 + 3) + 3 + 3