



Name :
Roll No. :
Invigilator's Signature :

**CS / B.OPTM / SEM-1 / BO-101 / 2010-11
2010-11**

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)

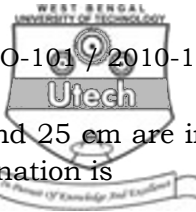
1. Choose the correct alternatives for the following : $10 \times 1 = 10$
 - i) Approximate wavelength of Yellow light emitted by Sodium vapour lamp is
 - a) 400 nm
 - b) 500 nm
 - c) 600 nm
 - d) 700 nm.
 - ii) A red flower kept in the green light will appear
 - a) Red
 - b) Green
 - c) White
 - d) Black.
 - iii) A ray of light enters from a denser medium into a rarer medium. The speed of light in rarer medium is twice that in denser medium. What is the critical angle for total internal reflection to take place ?
 - a) 30°
 - b) 45°
 - c) 60°
 - d) None of these.

1005

[Turn over]



- iv) A lens behaves converging lens in air and a diverging lens in water. The refractive index of the material of the lens is
- equal to unity
 - equal to 1.33
 - between unity and 1.33
 - greater than 1.33.
- v) When a small lamp is held 1.5 m above the surface of water in a tank, its image formed by reflection at the surface appears to coincide with the image of the bottom of the tank (μ of water = $4/3$). The depth of the tank is
- 1.5 m
 - 2 m
 - 1 m
 - 4 m.
- vi) Critical angle of light passing from glass to air is minimum for
- Red rays
 - Green rays
 - Yellow rays
 - Violet rays.
- vii) Velocities of light in diamond, glass and water decreases in the following order :
- water > glass > diamond
 - diamond > glass > water
 - diamond > water > glass
 - water > diamond > glass.
- viii) When the refractive index of the object space and image space is the same
- Nodal Planes and Unit Planes coincide
 - Nodal Planes and Focal Planes coincide
 - Focal Planes and Unit Planes coincide
 - Nodal Planes, Focal Planes and Unit Planes coincide.



- ix) Two thin Lenses of focal length 10 cm and 25 cm are in contact. The effective power of the combination is
- a) 0.5 D b) 14 D
c) 1 / 14 D d) 1 D.
- x) Principle of operation of Optical fibers is
- a) Refraction
b) Total internal reflection
c) Dispersion
d) Rectilinear Propagation.

GROUP - B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. Write a short note on spherical aberration. 15
3. Draw a diagram to show what is meant by angle of deviation in a Prism.

What is minimum angle of deviation ? For an equilateral prism of RI 1.5, calculate the minimum deviation angle.

$2 + 1 + 2$

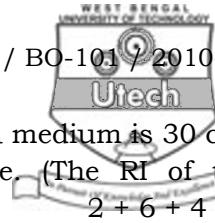
4. What do you mean by real and virtual images ? Discuss the situations for image formation in convex and concave lenses where the images are virtual.
5. Define refractive index and critical angle. Find out the relation between them. $3 + 2$
6. For a thin prism prove that $\delta = (\mu - 1) A$, where the symbols have their usual meanings.

GROUP - C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7.
 - a) State Fermat's principle.
 - b) Establish the laws of refraction from the principle.
 - c) Define optical path and geometrical path.



- d) The distance between two points in a medium is 30 cm. Find out the optical path distance. (The RI of the medium is 1.5). 2 + 6 + 4 + 3
- 8. a) Two thin lenses of focal lengths f_1 and f_2 are separated by a distance 'a'. Find the equivalent power of the combination.
- b) What is aberration ? What is chromatic aberration (with diagram) ? How can we minimize chromatic aberration ?
- c) Three lenses of focal lengths +3D, +5D, -6D are kept in contact. Find out the equivalent power and the equivalent focal length of the combination. 5 + 6 + 4
- 9. a) Obtain the formula for refraction at a curve surface.
- b) Use it to obtain Lens Makers formula.
- c) Find the minimum distance between the object and the real image formed by a convex lens. 5 + 5 + 5
- 10. a) Using matrix theory in paraxial optics
 - i) Derive the translation matrix
 - ii) Derive the refractive matrix.
- b) Why is matrix method useful in optics ? 6 + 6 + 3
- 11. a) Differentiate between
 - i) Step index and Graded index fiber.
 - ii) Single mode and Multimode fiber.
- b) What is numerical aperture of an optical fiber ?
- c) Derive Vergence equation for refraction at a curved surface for a ray travelling from rarer to denser media. 3 + 3 + 2 + 7

=====