REV-01
BOP/46/51

2025/12

SET B

BACHELOR OF OPTOMETRY
FIRST SEMESTER
MATHEMATICS AND GEOMETRICAL OPTICS-I
BOP-105

[USE OMR SHEET FOR OBJECTIVE PART]

Duration: 3 hrs. Full Marks: 70

Objective

Time: 30 mins. Marks: 20

Choose the correct answer from the following: *1×20=20*

1. What is the unit of vergence?
   a. Lux
   b. Armstrong
   c. Diopter
   d. Meter

2. Refractive Index is the ration of speed of light in vacuum to:
   a. Speed of light in the medium
   b. Wavelength of light
   c. Speed of light in vacuum
   d. Bending of light

3. For a full image, the height of the mirror should be:
   a. Equal to the height of person
   b. $\frac{1}{2}$ × height of person
   c. 2 × height of person
   d. 4 × height of person

4. In Plane mirrors using sign convention all the distances are measured from:
   a. Pole
   b. Principle focus
   c. Optical center
   d. Edge of the mirror

5. Concave mirror is a:
   a. Converging mirror
   b. Diverging mirror
   c. Non-diverging mirror
   d. None

6. Which mirror is used as rare view mirror in vehicles?
   a. Concave
   b. Convex
   c. Plane
   d. Spherical

7. Prism angle is the angle between:
   a. Angle between the direction of incidence and normal
   b. Angle between the direction of emergence and normal
   c. Angle between the direction of incidence and the direction of emergence
   d. The two refracting surfaces of the prism

8. Angular Dispersion is the angle between the directions of deviation of the:
   a. Less dispersive colors
   b. Extreme colors
   c. Refracting surfaces of a prism
   d. None

9. Dispersive power of a prism is the ratio of angular dispersion to:
   a. The mean deviation of the prism
   b. The refractive index of the prism
   c. The prism angle
   d. The direction of deviation

10. A low Abbe's number signifies:
    a. Low dispersion
    b. Maximum dispersion
    c. No dispersion
    d. High dispersion

11. What is the value of i^3?
    a. i
    b. -i
    c. 1
    d. -1

12. What is the conjugate of $3 + 4i$?
    a. $3 - 4i$
    b. $3 + 4i$
    c. $-3 + 4i$
    d. $-3 - 4i$

13. What is argand plane used for?
    a. Plotting real numbers
    b. Plotting complex numbers
    c. Plotting vectors
    d. Plotting matrices

14. If $z = 2 + 5i$, what is the value of $|z|$?
    a. $\sqrt{2^2 + 5^2}$
    b. $\sqrt{2^2 - 5^2}$
    c. 2+5
    d. 2-5

15. Dot Product is also known as:
    a. Scalar Product
    b. Vector Product
    c. Norm
    d. Determinant

16. Order of a matrix is represented as mxn, where m is the:
    a. Number of Columns
    b. Rank
    c. Either Rows or Columns
    d. Number of Rows

17. In how many ways we can add two vectors geometrically?
    a. 1
    b. 2
    c. 3
    d. 4

18. A matrix having zero determinant is called:
    a. Identity Matrix
    b. Null Matrix
    c. Singular Matrix
    d. Non-Singular Matrix

19. How many types of wave fronts are there?
    a. 1
    b. 2
    c. 3
    d. 4

20. Curvature is mathematically defined as reciprocal of:
    a. Length
    b. Vergence
    c. Focal length
    d. Radius of curvature

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(Descriptive)

Time : 2 hr. 30 mins. Marks : 50

[Answer question no.1 & any four (4) from the rest]

1. Define Dot Product, Cross Product and Angle between two vectors. 5+5=10

   Also find the angle between the vectors $\overrightarrow{A} = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$ and $\overrightarrow{B} = \begin{bmatrix} \frac{1}{2} \\ \frac{\sqrt{3}}{2} \end{bmatrix}$

   Define Triangular Law of Vector addition and derive the resultant vector and its direction.

2. Define Scalar and Vector. 2+4+4=10

   Define Vector Addition, Vector Subtraction and Vector Norm.

   a) Add the vectors $\overrightarrow{A} = \begin{bmatrix} 2 & 4 & 6 \\ 1 & 5 & 10 \\ 7 & 8 & 0 \end{bmatrix}$ and $\vec{B} = \begin{bmatrix} 3 & 9 & 11 \\ 2 & 7 & 20 \\ 11 & 4 & 6 \end{bmatrix}$

   b) Subtract the vectors $\overrightarrow{A} = \begin{bmatrix} 2 & 8 \\ 10 & 5 \end{bmatrix}$ and $\overrightarrow{B} = \begin{bmatrix} 1 & 9 \\ 15 & 2 \end{bmatrix}$

   c) Find the norm of the vector $\overrightarrow{P} = \begin{bmatrix} 3 \\ 4 \end{bmatrix}$

3. Answer the following: 2+2+3+3=10

   a) If $z = 1 + i$, find the argument of z.

   b) Find the value of $i + i^2 + i^3 + i^4$

   c) If $z_1 = a_1 + ib_1$ and $z_2 = a_2 + ib_2$, find $\frac{z_1}{z_2}$

   d) Convert $z = x + iy$ into Polar or Trigonometric form.

4. Explain the terms Matrix, Order of a Matrix, Rank of a matrix and Determinant of a matrix with suitable numerical example of each. 5+5=10

   Add, Subtract and Multiply the Matrices:

   $A = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$ and $B = \begin{bmatrix} 2 & 1 & 3 \\ 6 & 4 & 5 \\ 9 & 8 & 7 \end{bmatrix}$

5. Define the terms: 2×5=10

   a) Curvature, its mathematical definition and its unit.

   b) Refractive index and its dependence on wavelength

   c) Fermat's principal

   d) Vergence

   e) Huygen's principal

6. Define the terms: 2×5=10

   a) Plane Mirrors and Height of plane mirrors

   b) Rotation of plane mirrors

c) Reflection by Spherical Mirrors
d) Parallax Approximation
e) Sign convention and its rules

7. Explain in brief about the image formation by concave and convex mirrors using ray diagram. Also define the terms Reflectivity and Transmissivity. 3+3+2+2=10

8. Explain the terms: 2×5=10
a) Thick and thin prisms
b) Angle of prism
c) Refractive Index of prism
d) Dispersive power of prism
e) Abbe's Number

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