36088-36151-36214-36276



# BRAINWARE UNIVERSITY

## Term End Examination 2025-2026

**Programme – B.Tech.(CSE)-2024/B.Tech.(CSE)-AIML-2024/B.Tech.(CSE)-DS-2024/B.Tech.(CSE)-AIR-2024/B.Tech.(CSE)-CYS-2024/B.Tech.(CSE)-2025/B.Tech.(CSE)-AIML-2025/B.Tech.(CSE)-CYS-2025/B.Tech.(CSE)-DS-2025/B.Tech.(CSE)-AIR-2025**

**Course Name – Algebra and Vector Calculus**

**Course Code - BBS00002**

**( Semester II )**

**Full Marks : 60** **Time : 2:30 Hours**

[The figure in the margin indicates full marks. Candidates are required to give their answers in their own words as far as practicable.]

### Group-A

(Multiple Choice Type Question) 1 x 15=15

1. *Choose the correct alternative from the following :*

(i) Choose number of solutions of the system of equations $x + 2y - z = 2$, $4x + 8y - 4z = 8$.

a) infinitely many solutions
b) no solutions
c) a unique solution
d) none of these

(ii) Identify the rank of the matrix $\begin{pmatrix} 2 & 2 & 1 \\ 6 & 6 & 3 \end{pmatrix}$ and it is

a) 2
b) 3
c) 1
d) none of these.

(iii) Identify the value of '$a$' for which rank of the matrix $\begin{pmatrix} 2 & 0 & 1 \\ 5 & a & 3 \\ 0 & 3 & 1 \end{pmatrix}$ is less than 3.

a) $\frac{3}{4}$
b) $\frac{3}{5}$
c) $\frac{3}{2}$
d) 1

(iv) If $A$ is an orthogonal matrix then identify the correct option.

a) $A = A^{-1}$

b) $A = -A^{-1}$

c) $A^T = A^{-1}$

d) $A^T = -A^{-1}$

(v) If a 2x3 matrix has rank 2 then identify the correct option:

a) The matrix is singular

b) The matrix has two linearly independent rows

c) The matrix has three linearly independent columns

d) The matrix is not valid as it should be a square matrix

(vi) Identify the correct option: Let $f = x^2y + y^2x + z$. Then $grad\ f$ at $(0,0,0)$ equals to

a) (3,3,2)

b) (0,0,1)

c) (1,3,2)

d) (1,1,2)

(vii) Identify the correct option. If $\phi$ and $\psi$ are two scalar point functions, then $\vec{\nabla}(\phi\psi)$ equals to

a) $\varphi\vec{\nabla}(\psi) + \psi\vec{\nabla}(\varphi)$

b) $\vec{\nabla}(\psi) + \vec{\nabla}(\varphi)$

c) $\vec{\nabla}(\psi)\vec{\nabla}(\varphi)$

d) 0

(viii) Determine which of the following statements is correct.

a) Green's theorem is a particular case of Stokes theorem

b) Stroke's theorem is a particular case of green's theorem

c) Both Green's theorem and Stroke's theorem are the same

d) None of these

(ix) Identify the correct option.

A standard form of Boolean expression contains:

a) Minterms only

b) Maxterms only

c) Minterms or Maxterms

d) Logical constants only

(x) In a Boolean algebra B, a b= b. Then compute a.b.

a) a

b) b

c) a'

d) Cannot determined from the given data

(xi) Choose the correct option:

The determinant of a product of two matrices A and B is equal to:

a) |A| |B|

b) |A||B|

c) |A| - |B|

d) $|A|^T\ |B|$

(xii) Select the correct option.

The rank-nullity theorem for a linear transformation T states that

a) The dimension of the domain is equal to the rank of T plus the nullity of T.

b) The dimension of the domain is equal to the rank of T

c) The dimension of the codomain is equal to the rank of T plus the nullity of T.

d) The nullity of T is equal to the rank of T plus the dimension of the domain.

(xiii) If a matrix has distinct eigen values then determine the nature of eigenvectors

a) They must be orthogonal

b) They must be linearly dependent

c) They must be linearly independent

d) They must have the same magnitude

(xiv) Select the correct option.
A given nxn orthogonal matrix has columns that

a) Form a linearly dependent set

b) Are orthogonal unit vectors

c) Are always symmetric

d) Contain only ones and zeros

(xv) Select the correct option.

A determinant of an orthogonal matrix always satisfies

a) det(A)=0

b) det(A)=1 or −1

c) det(A)=2

d) det(A)= −2

**Group-B**
(Short Answer Type Questions) 3 x 5=15

2. Calculate the directional derivative of $f(x, y, z) = x^2y + z^2$ at the point $(1,2,1)$ in the direction $\hat{\imath} + 2\hat{\jmath} + 2\hat{k}$. (3)

3. Identify the kernel of the mapping $T: \mathbb{R}^3 \rightarrow \mathbb{R}^3$ defined by $T(x_1, x_2, x_3) = (x_1 - x_2, x_2 + x_3, x_1 + x_3)$. (3)

4. Use Cramer's rule to solve the given system of equations: x-y=2, x+4y=5. (3)

5. Define in a Boolean Algebra B, a+b=$(a'.b')'$ (3)

6. Test the matrix A=$\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$ is diagonalizable or not. (3)

**OR**

Justify that the determinant of a skew-symmetric matrix of odd order is zero. (3)

**Group-C**
(Long Answer Type Questions) 5 x 6=30

7. Identify the eigenvalues and eigenvectors of matrix A=$\begin{pmatrix} 5 & 4 \\ 1 & 2 \end{pmatrix}$. (5)

8. Show that (x+ y)'=x'y'. (5)

9. If $\boldsymbol{F} = grad\,(x^3 + y^3 + z^3 - 3xyz)$, then calculate the value of $div\,\boldsymbol{F}$ and $curl\,\boldsymbol{F}$. (5)

10. Using the Gauss-Jordan method, compute the inverse of the matrix $\begin{pmatrix} 1 & 2 & 3 \\ 0 & 1 & 2 \\ 0 & 0 & 1 \end{pmatrix}$. (5)

11. Examine the Rank–Nullity Theorem for the linear transformation $T: \mathbb{R}^3 \to \mathbb{R}^2$ is defined by $T\,(x, y, z) = (x + y, y + z)$. (5)

12. Evaluate the eigenvalues and any one eigenvector of the matrix $\begin{bmatrix} 0 & 0 & -1 \\ 1 & 0 & 0 \\ 1 & 1 & -1 \end{bmatrix}$. (5)

**OR**

If $\begin{vmatrix} x^3 + 3x & x - 1 & x + 3 \\ x + 1 & 1 - 2x & x - 4 \\ x - 2 & x + 4 & 3x \end{vmatrix} = ax^4 + bx^3 + cx^2 + dx + e$ be an identity in $x$ where $a, b, c, d, e$ are constants, then evaluate the value of $e$. (5)

*****************************************