



16604



BRAINWARE UNIVERSITY

Term End Examination 2025-2026

Programme – B.Tech.(BT)-2024/B.Tech.(BT)-2025

Course Name – Calculus and Linear Algebra

Course Code - BBS00007

(Semester I)

Library
Brainware University
398, Ramkrishnapur Road, Barasat
Kolkata, West Bengal-700125

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) If $f(x)$ is continuous in $[a, a + h]$, derivable in $(a, a + h)$, then choose the correct option where

$$f(a + h) = f(a) + hf'(a + \theta h)$$

a) θ is an integer

b) $0 < \theta < 1$

c)

d) None of these

$$\theta > 1$$

(ii) Select the correct value of $\beta\left(\frac{1}{2}, \frac{1}{2}\right)$

a) π

b) $\sqrt{\pi}$

c) $\frac{\sqrt{\pi}}{2}$

d) $\frac{\pi}{2}$

(iii) For all second-degree polynomials with $y = ax^2 + bx + k$, it is seen that the Rolles' point is at $c = 0$. Also, the value of k is zero. Choose the correct value of b .

a) 0

b) 1

c) -1

d) 56

(iv) Select theorem that can be applied to the function $f(x) = x^3$ in the interval $[1, 3]$

a) Rolle's Theorem

b) Lagrange's Mean Value Theorem

c) Cauchy's Mean Value Theorem

d) None of these

(v) Compute $\int_{-\pi}^{\pi} \sin 6x dx =$

a) 0

b) 1

c) -1

d) None of these

- (vi) Identify the sum of series $1+1/2+1/2^2 + \dots$
- a) 2
b) 3/2
c) 4/3
d) 10/9
- (vii) Choose the correct value of $\lim_{(x,y) \rightarrow (0,0)} \frac{x^3 - y^3}{x - y} =$
- a) 0
b) 1
c) 1/2
d) None of these
- (viii) If $f(x, y) = x^2y$ then calculate $df =$
- a) $2x^2dx + dy$
b) $x - 2dy$
c) $x + dy$
d) $2xydx + x^2dy$
- (ix) Calculate $\Gamma(5) =$
- a) 24
b) 2
c) 3
d) 4
- (x) If the rank of a 3×2 matrix is 2, then Identify the matrix
- a) The matrix is singular
b) The matrix has two linearly independent rows
c) The matrix has two linearly independent columns
d) The matrix is not valid as it should be a square matrix
- (xi) Select the rank of an identity matrix is always:
- a) 0
b) 1
c) The order of the matrix
d) Undefined
- (xii) Choose which of the following is the zero vector of \mathbb{R}^3 under the standard vector addition.
- a) (0,0)
b) (0,0,0)
c) (0,0,0,0)
d) (1,1,1)
- (xiii) Choose the correct option The set of vectors (2,1,0), (1,1,0), (4,2,0) of \mathbb{R}^3 are
- a) linearly independent but not a basis
b) linearly dependent
c) basis
d) None of these
- (xiv) If a matrix has all its eigenvalues equal to 1, then choose the determinant value.
- a) 0
b) 4
c) 3
d) 1
- (xv) If a matrix has distinct eigenvalues 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

Group-B

(Short Answer Type Questions)

3 x 5=15

2. Define the Maclaurin Series expansion of e^{-x} . (3)
3. Explain the convergence of the series $\sum_{n=1}^{\infty} \frac{2^n - 1}{3^n}$. (3)
4. Calculate all the first partial derivatives of $f(x, y) = x^3 e^{-2y} + y^{-2} \cos(x)$. (3)
5. Determine whether the vectors $v_1 = (1, 2, 3)$, $v_2 = (1, 0, 1)$, $v_3 = (1, -1, 5)$ in \mathbb{R}^3 is linearly dependent or linearly independent. (3)

6. If $a+b+c \neq 0$ and $\begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix} = 0$ then illustrate that $a = b = c$. (3)

OR

- Calculate the inverse, if it exists, of the matrix $\begin{pmatrix} 0 & -2 & -3 \\ 1 & 3 & 3 \\ -1 & -2 & -2 \end{pmatrix}$. (3)

Group-C

(Long Answer Type Questions)

5 x 6=30

7. Given $A = \begin{pmatrix} 1 & 2 & 3 \\ 0 & 1 & 2 \\ 0 & 0 & 1 \end{pmatrix}$ use elementary row operations on A to deduce A^{-1} (5)

8. Recognize that $\frac{(b-a)}{\sqrt{1-a^2}} < \sin^{-1} b - \sin^{-1} a < \frac{(b-a)}{\sqrt{1-b^2}}$ if $0 < a < b < 1$ (5)

9. Illustrate $\int_0^{\frac{\pi}{2}} \sin^4 x \cos^5 x \, dx = \frac{8}{315}$ (5)

10. Discover the interval and radius of convergence $\sum \frac{x^n}{n!}$. (5)

11. Using definition calculate $f_x(0,0)$ and $f_y(0,0)$ for the function (5)

$$f(x,y) = \begin{cases} \frac{x^2+y^2}{x+y}, & (x,y) \neq 0 \\ 0, & (x,y) = 0 \end{cases}$$

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

OR

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