

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

Bachelor of Technology (Civil Engineering) SEMESTER - 1 Summer 2026 (Supply.)

Course :Bachelor of Technology (Civil Engineering) Branch : Engineering and Technology

Semester : SEMESTER - 1

Subject Code & Name: 24AF1000BS101 - ENGINEERING MATHEMATICS – I

Time : 3 Hours]

[Total Marks : 60

Instructions to the Students:

1. Each question carries 12 marks.
 2. Question No. 1 will be compulsory and include objective-type questions.
 3. Candidates are required to attempt any four questions from Question No. 2 to Question No.6
 4. Use of non-programmable scientific calculators is allowed.
 5. Assume suitable data wherever necessary and mention it clearly.
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Q1. Objective type questions. (Compulsory Question)

12

- 1 Product of Eigen values equals:
A) Rank
B) Determinant
C) Trace
D) Order
- 2 The system $AX = B$ is consistent if:
A) $\text{Rank}(A) \neq \text{Rank}(A:B)$
B) $\text{Rank}(A) = \text{Rank}(A:B)$
C) Determinant is zero
D) Matrix is diagonal
- 3 Cayley–Hamilton theorem is useful for:
A) Finding transpose
B) Finding inverse of matrix
C) Finding determinant only
D) Finding rank only
- 4 The function $x^2 + y^2$ is homogeneous of degree:
A) 1
B) 2
C) 3
D) 0
- 5 For a homogeneous function of degree n , $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = nu$. This theorem is called:
A) Green's theorem
B) Euler's theorem
C) Stokes theorem
D) Taylor theorem

- 6 Jacobian is mainly used in:
- A) Matrix inversion
 - B) Transformation of variables
 - C) Eigen values
 - D) Integration by parts

- 7 Taylor series expansion gives:
- A) Exact determinant
 - B) Polynomial approximation
 - C) Matrix rank
 - D) Eigen values

- 8 The expansion of a function about (0,0) is called:
- A) Fourier series
 - B) Maclaurin series
 - C) Laplace series
 - D) Binomial series

- 9 The reduction formula for $\int_0^{\frac{\pi}{2}} \sin^n x \, dx$ is generally used when n is:
- A) Negative
 - B) Fractional
 - C) Positive integer
 - D) Zero only

- 10 The curve $r = a(1 + \cos \theta)$ represents:
- A) Cardioid
 - B) Parabola
 - C) Hyperbola
 - D) Spiral

- 11 The geometrical interpretation of double integral is
- A) Area under a surface
 - B) Straight line
 - C) Determinant
 - D) Vector Product

- 12 Triple integrals are mainly used to calculate:
- A) Area
 - B) Length
 - C) Volume
 - D) Curvature

Q2. Solve the following.

- A) Find the rank of matrix A by reducing it to Normal form, where

$$A = \begin{bmatrix} 6 & 1 & 3 & 8 \\ 4 & 2 & 6 & -1 \\ 10 & 3 & 9 & 7 \\ 16 & 4 & 12 & 15 \end{bmatrix}$$

- B) Solve the system of equations 6
 $x + 2y + 4z + w = 0; \quad 2x + 4y + 8z + 2w = 0; \quad 3x + 6y + 2z = 0.$

Q3. Solve the following.

- A) If $u = \log(x^2 + y^2)$. Prove that $\frac{\partial^2 u}{\partial x \partial y} = \frac{\partial^2 u}{\partial y \partial x}$. 6
- B) If $u = f(y - z, z - x, x - y)$ show that $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = 0$. 6

Q4. Solve Any Two of the following.

- A) If $u = xyz, v = x^2 + y^2 + z^2, w = x + y + z$ then prove that 6
 $\frac{\partial(u, v, w)}{\partial(x, y, z)} = -(x - y)(y - z)(z - x).$
- B) Expand $f(x, y) = \cos x \sin y$ as far as the terms of third degree. 6
- C) Find the maximum and minimum values of the function 6
 $f(x, y) = x^3 + 3xy^2 - 15x^2 - 15y^2 + 72x.$

Q5. Solve Any Two of the following.

- A) Evaluate $\int_0^{\pi/6} \cos^4 3\theta \sin^3 6\theta \, d\theta$. 6
- B) Trace the curve $xy^2 = 4a^2(2a - x)$. 6
- C) Trace the curve $r = a \cos 2\theta$. 6

Q6. Solve Any Two of the following.

- A) Evaluate the integral $\int_0^1 \int_{y^2}^1 \int_0^{1-x} x \, dz \, dx \, dy$. 6
- B) Change the order of integration and evaluate $\int_0^1 \int_{x^2}^x xy \, dx \, dy$. 6
- C) Find the area bounded by the parabola $y = x^2$ and the line $y = 2x + 3$. 6

*** End ***