

Indian Maritime University
(A Central University, Govt of India)

Sep/Oct'25 SE

Programme Name: B Tech (NAOE/NASB)

Semester: II

Subject Code: UG12T2201/UG13T1201

Subject Name: Engineering Mathematics-II

Date: 25.09.2025

Max Marks: 70

Duration: 03 Hrs

Pass Marks: 35

General Instructions

- (i) All Sections (A, B & C) are to be attempted.
- (ii) Options, if any, are specified in respective section.

Section A

Ten MCQs/Fill in the Blanks of 01 Mark each – Choose the correct answer as applicable.

1. If A is an $n \times n$ matrix, then the product of its eigenvalues is equal to: []

- (a) Determinant of A
- (b) Trace of A
- (c) Rank of A
- (d) Index of A

2. The quadratic form $Q(x,y) = x^2 - y^2$ is: []

- (a) Positive definite
- (b) Negative definite
- (c) Indefinite
- (d) Semi-definite

3. If $F = (x^2y) i + (yz) j + (xz) k$, then $\text{div } F$ is: []

- (a) $x^2 + z$
- (b) $2xy + z$
- (c) $x^2 + y$
- (d) $2x + y + z$

4. The divergence of curl of any vector field is: []

- (a) zero
- (b) infinity
- (c) unity
- (d) undefined

5. The Laplace transform of $\cos(at)$ is: []

- (a) $\frac{s}{(s^2+a^2)}$
- (b) $\frac{a}{(s^2+a^2)}$
- (c) $\frac{1}{(s+a)}$
- (d) $\frac{s}{(s^2-a^2)}$

6. The inverse Laplace transform of $\frac{1}{s^2}$ is: []

- (a) 1
- (b) t
- (c) $\frac{t^2}{2}$
- (d) e^t

7. The general solution of a homogeneous linear PDE with constant coefficients is obtained by: []

- (a) Method of separation of variables
- (b) Method of characteristics
- (c) Method of auxiliary equations
- (d) None of these

8. The Fourier cosine transform of e^{-ax} is: []

- (a) $\frac{a}{(a^2+p^2)}$
- (b) $\frac{p}{(a^2+p^2)}$
- (c) $\frac{1}{(a^2+p^2)}$
- (d) $\frac{a^2}{(a^2+p^2)}$

9. The Fourier sine transform of $\frac{1}{x}$ is: []

- (a) $\frac{\pi}{2}$
- (b) $\frac{1}{p}$
- (c) $\log p$

(d) 0

10. If $F\{f(x)\} = F(p)$, then $F\{f'(x)\} =$

[]

(a) $-pF(p)$

(b) $pF(p)$

(c) $F(p)/p$

(d) $p^2F(p)$

Section B

Five Questions of 02 Marks each

11. Find the eigenvalues of the matrix $A = \begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix}$

12. Find the gradient of $f(x,y,z) = x^2 + y^2 + z^2$ at $(1,2,3)$.

13. Find the half-range sine series for $f(x) = x$ in $(0, \pi)$.

14. Solve the PDE: $\frac{\partial^2 z}{\partial x^2} + \frac{\partial^2 z}{\partial y^2} = 0$.

15. Find the Fourier transform of $f(x) = e^{-|x|}$.

Section C

Seven Questions of 10 Marks each of which any 05 questions to be answered.

16. Diagonalize the matrix $A = \begin{bmatrix} 4 & 1 \\ 1 & 3 \end{bmatrix}$ and find its canonical form.

17. Verify the Divergence theorem for the vector field $F = (x \mathbf{i} + y \mathbf{j} + z \mathbf{k})$ over the region bounded by the unit cube $0 \leq x, y, z \leq 1$.

18. Solve using Laplace transforms: $y'' + 4y = \sin 2t$, $y(0) = 0$, $y'(0) = 1$.

19. Compute the half-range cosine series of $f(x) = x(\pi - x)$ in the interval $(0, \pi)$. Hence deduce that $\sum (1/\pi^2) = \pi^2/6$.

20. Solve the PDE by method of separation of variables: $u_t = u_{xx}$, $0 < x < \pi$, $u(0,t) = u(\pi,t) = 0$, $u(x,0) = \sin(3x)$.

21. Find the Fourier transform of $f(x) = 1/(1+x^2)$. Hence evaluate $\int_0^\infty \frac{\cos px}{(1+x^2)} dx$.

22. Reduce the quadratic form $Q = x^2 + y^2 + z^2 + 2xy + 2yz + 2zx$ to canonical form and determine its rank, index, and signature.