

Indian Maritime University
(A Central University, Govt. of India)
End Semester Examinations – June 2024
Programme Name: B Tech (NAOE/NASB)
Semester: II
Subject Code: UG12T2201/UG13T1201
Subject Name: Engineering Mathematics II

Date: 28.05.2024

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 $D = \text{diag}(d_1, d_2, d_3, \dots, d_n)$, where $d_i \neq 0$ for all $i=1, 2, \dots, n$ then D^{-1} is equal to
 - a. D
 - b. $\text{diag}(d_1^{-1}, d_2^{-1}, \dots, d_n^{-1})$
 - c. I_n
 - d. Null matrix
2. The eigen values of $\begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$ are
 - a. 0,0,0
 - b. 0,0,1
 - c. 0,0,3
 - d. 1,1,1
3. If the velocity vector in a two-dimensional flow field is given by $V = 2xyi + (2y^2 - x^2)j$, curl V will be
 - a. $2y^2j$
 - b. $6y k$
 - c. 0
 - d. $-4xk$
4. The maximum value of the directional derivative of the function $\phi = 2x^2 + 3y^2 + 5z^2$ at a point $(1, 1, -1)$ is

- a. 10
- b. -4
- c. $\sqrt{152}$
- d. 152

5. Laplace transform of $f(t) = t \sin 3t$ is

- a. $\frac{3}{s^2 + 9}$
- b. $\frac{3s}{(s^2 + 3)^2}$
- c. $\frac{6s}{(s^2 + 3)^2}$
- d. $\frac{6s}{(s^2 + 9)^2}$

6. $L^{-1} \left[\frac{1}{(s+1)^2} \right]$ is

- a. te^t
- b. $-te^t$
- c. t^2e^{-t}
- d. te^{-t}

7. If $f(x) = |x|$ in $[-3, 3]$ then Fourier coefficient a_0 is

- a. 1
- b. 2
- c. 3
- d. 4

8. The auxiliary equation for the PDE : $(1-x)p+(2-y)q = 3-z$

- a. $\frac{dx}{1-x} = \frac{dy}{2-y} = \frac{dz}{3-z}$
- b. $\frac{dx}{p} = \frac{dy}{2-y} = \frac{dz}{3-z}$
- c. $\frac{dx}{2-y} = \frac{dy}{1-x} = \frac{dz}{3-z}$
- d. $\frac{-dx}{1-x} = \frac{dy}{2-y} = \frac{dz}{3-z}$

9. The general solution for the PDE: $(4D^2 - 12DD' + 9D'^2)z = 0$ is

- a. $\phi_1(y + 3x) + x\phi_2(y + 3x)$
- b. $\phi_1\left(y + \frac{3}{2}x\right) + x\phi_2\left(y + \frac{3}{2}x\right)$
- c. $\phi_1\left(y - \frac{3}{2}x\right) + x\phi_2\left(y - \frac{3}{2}x\right)$
- d. $\phi_1(y - 3x) + x\phi_2(y - 3x)$

10. If $F\{f(x)\} = \bar{f}(s)$, then $F\{f(ax)\} =$

- a. $\frac{1}{a} \bar{f}\left(\frac{a}{s}\right)$
- b. $\frac{1}{a} \bar{f}(s)$
- c. $\frac{1}{a} \bar{f}(a)$
- d. $\frac{1}{a} \bar{f}\left(\frac{s}{a}\right)$

Section B

Five Questions of 02 Marks each

11. Compute the Eigen values of the matrix $\begin{bmatrix} 1 & 1 & 3 \\ 1 & 5 & 1 \\ 3 & 1 & 1 \end{bmatrix}$
12. A vector field is given by $F = \sin y \mathbf{i} + x(1 + \cos y)\mathbf{j}$. Evaluate the line integral over a circular path given by $x^2 + y^2 = a^2, z = 0$
13. Compute the Laplace transform of $t^3 e^{-3t}$ by using multiplication rule.
14. If the Fourier sine transform of $f(x) = \frac{1 - \cos n\pi x}{n^2 \pi^2}$ ($0 \leq x \leq \pi$), compute $f(x)$
15. Solve the PDE: $\frac{y^2 z}{x} p + xzq = y^2$

Section C

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

16. Reduce the following quadratic form to canonical form and find its rank and signature: $x^2 + 4y^2 + 9z^2 + t^2 - 12yz + 6zx - 4xy - 2xt - 6zt$
17. Verify and apply divergence theorem for $2xz^2 \mathbf{i} - y^2 \mathbf{j} + 4xz^2 \mathbf{k}$ taken over the region of the first octant of the cylinder $y^2 + z^2 = 9$ and $x = 0, x = 2$
18. Apply Laplace transform, Solve $(D^2 + 2D + 5)y = e^{-t} \sin t$, given that $y(0) = 0, y'(0) = 1$
19. Solve $x^2(y-z)p + y^2(z-x)q = z^2(x-y)$ by Lagrange's Linear equation.
20. Find the Fourier transform of $f(x) = \begin{cases} 1 - x^2, & |x| \leq 1 \\ 0, & |x| > 1 \end{cases}$
Hence evaluate $\int_0^\infty \frac{x \cos x - \sin x}{x^3} \cos \frac{x}{2} dx$
21. Expand $f(x) = \begin{cases} \frac{1}{4} - x, & \text{if } 0 < x < \frac{1}{2} \\ x - \frac{3}{4}, & \text{if } \frac{1}{2} < x < 1 \end{cases}$
as the Fourier series of sine terms.
22. Apply Stoke's theorem evaluate $\int_C [(x+y)dx + (2x-z)dy + (y+z)dz]$ where C is the boundary of the triangle with vertices $(2, 0, 0), (0, 3, 0)$ and $(0, 0, 6)$