

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

Sep/Oct'25 SE

Programme Name: B Tech (ME)

Semester: II

Subject Code: UG11T5201

Subject Name: Engineering Mathematics II

Date: 08.09.2025

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

Answer All Questions

[10 × 1 =10 Marks]

Choose the correct answer as applicable.

1. $L\{te^{2t}\}$ is equal to

A. $\frac{1}{s-2}$

B. $2(s-2)^2$

C. $\frac{1}{(s-2)^2}$

D. $\frac{2!}{s^2}$

2. $L^{-1}\left\{\frac{1}{s} + \frac{1}{s^3}\right\} =$

A. 1

B. $1+t$

C. $1 + \frac{t^2}{2}$

D. $1 - \frac{t^2}{2}$

3. $L^{-1}\left\{\frac{e^{-as}}{s^3}\right\} =$

- A. $\frac{1}{2}(t-a)^2 u(t-a)$
- B. $(t-a)^2 u(t-a)$
- C. $(t-a)u(t-a)$
- D. $\frac{1}{3}(t-a)^3 u(t-a)$

4. The value of m for which $3y - 5x^2 + my^2$ is a harmonic function is

- A. 5
- B. -5
- C. 0
- D. 3

5. Residue of $f(z) = \frac{2+3\sin \pi z}{z(z-1)^2}$ at $z=0$ is

- A. 1
- B. 3
- C. 2
- D. i

6. If $f(x) = x + x^2, -\pi < x < \pi$ be represented as a Fourier series

$\frac{a_0}{2} + \sum_{n=1}^{\infty} (a_n \cos nx + b_n \sin nx)$ then a_0 is equal to

- A. π^2
- B. $\frac{\pi^2}{3}$
- C. $2\frac{\pi^2}{3}$
- D. 0

7. The period of the function $f(x) = \sin 2\pi x$ is

- A. $\frac{1}{2}$
- B. 1
- C. 0
- D. $\frac{1}{3}$

8. Fourier transform of the function

$$f(t) = \begin{cases} 1, & -1 < t < 1 \\ 0, & \text{elsewhere} \end{cases}$$

- A. $\sin s$
- B. $\frac{\sin s}{s}$

- C. $\frac{\cos s}{s}$
 D. $\frac{2 \sin s}{s}$

9. The Fourier sine transform of $f(t) = \frac{1}{t}$ is

- A. s
 B. $\frac{1}{s}$
 C. $\frac{\pi}{2}$
 D. e^{is}

10. The necessary conditions for a function $f(z) = u(x, y) + iv(x, y)$ to be analytic are

- A. $u_x = v_y, u_y = v_x$
 B. $u_x = -v_y, u_y = -v_x$
 C. $u_x = -v_y, u_y = v_x$
 D. $u_x = v_y, u_y = -v_x$

Section B

Answer all the following :

[5 × 2 = 10 Marks]

11. If $f(t) = t^2$ and $f(t+1) = f(t)$ find $L\{f(t)\}$
 12. Using the Fourier series expansion of $f(t) = 1 - t^2$ when $-1 \leq t \leq 1$ find a_0 .
 13. Find the analytic function $f(z) = u + iv$ where $v = e^x \sin y$.
 14. Find the Fourier transform of $f(t) = e^{-|t|}$ where $a > 0$ and $-\infty < t < \infty$
 15. Use Newton Raphson method to deduce the iterative procedure

$$x_{n+1} = \frac{1}{2} \left(x_n + \frac{a}{x_n} \right)$$

For evaluating \sqrt{a} as the solution of $x^2 - a = 0$.

Section C

Answer any 5 out of following 7 questions.

16. (a) Find the Laplace transform of $te^{-2t} \sin 3t$ (4)
 (b) Express the following function in terms of unit step function and find its Laplace Transform

$$f(t) = \begin{cases} 0, & 0 < t < 1 \\ t-1, & 1 < t < 2 \\ 1, & t > 2 \end{cases} \quad (6)$$

17. (a) Evaluate $L^{-1}\left\{\frac{1}{s^2(s+1)^2}\right\}$ using Convolution theorem. (4)

(b) Using Laplace transforms, find the solution of the initial value problem $(D^2 - 3D + 2)y = 4e^{2t}$ with $y(0) = -3$ and $y'(0) = 5$ (6)

18. (a) Expand the following function in Laurent's series

$$f(z) = \frac{1}{(z-1)(z+3)} \text{ for } 1 < |z| < 3 \quad (5)$$

(b) Evaluate the integral $\oint_C \frac{z^2 - 2z}{(z+1)^2(z^2+4)} dz$ where C is the circle $|z| = 10$ (5)

19. (a) Find the value of a_n when $f(x) = x \sin x$, $0 < x < 2\pi$ is expanded in Fourier series. (3)

(b) Find the Fourier series for the function $f(x)$ if

$$f(x) = \begin{cases} -\pi, & -\pi < x < 0 \\ x, & 0 < x < \pi \end{cases} \quad (7)$$

20. (a) Use Cauchy's integral formula to evaluate

$$\oint_C \frac{\log z}{(z-1)^3} dz \text{ where } C: |z-1| = \frac{1}{2} \quad (5)$$

(b) If $a_0 = \frac{2\pi^2}{3}$, $a_n = \frac{4}{n^2}(-1)^n$, $b_n = 0$ are the Fourier constants obtained in expanding

the function $f(x) = x^2$, $-\pi < x < \pi$ in Fourier series then show that $\sum_{n=1}^{\infty} \frac{1}{n^4} = \frac{\pi^4}{90}$. (5)

21. (a) Find the Fourier transform of

$$f(x) = \begin{cases} 1-x^2, & |x| \leq 1 \\ 0, & |x| > 1 \end{cases} \quad (5)$$

(b) If

$$f(x) = e^{-bx}, \quad b > 0, x \geq 0$$

find the Fourier cosine transform of $f(x)$ and hence evaluate

$$\int_0^{\infty} \frac{\cos sx}{b^2 + s^2} ds$$

(5)

22. (a) Find a real root of the equation

$$f(x) = x^3 - 3x - 5 = 0$$

Using Regula – Falsi method correct to three decimal places.

(5)

(b) Solve the following system of equations using Gauss – Jordan Elimination procedure

$$x_1 + 2x_2 + 4x_3 = 18$$

$$x_1 + 3x_2 + 2x_3 = 13$$

$$3x_1 + x_2 + 3x_3 = 14$$

(5)

