

# CBCS SCHEME



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15MAT31

## Third Semester B.E. Degree Examination, Dec.2023/Jan.2024 Engineering Mathematics – III

Time: 3 hrs.

Max. Marks: 80

*Note: Answer any FIVE full questions, choosing ONE full question from each module.*

### Module-1

- 1 a. Obtain the Fourier expansion of the function  $f(x) = x$  over the interval  $(-\pi, \pi)$ . Deduce that
- $$\frac{\pi}{4} = \sum_{n=1}^{\infty} \frac{(-1)^{n+1}}{(2n-1)} \quad (05 \text{ Marks})$$
- b. Find the Fourier series expansion for the function  $f(x) = (\pi - x)^2$  in the interval  $(0, 2\pi)$ . (05 Marks)
- c. Compute the constant term and the first harmonic in the Fourier series of  $f(x)$  given by the following table:

x	0	$\pi/3$	$2\pi/3$	$\pi$	$4\pi/3$	$5\pi/3$	$2\pi$
f(x)	1.0	1.4	1.9	1.7	1.5	1.2	1.0

(06 Marks)

OR

- 2 a. Expand  $f(x) = e^{-ax}$  as a Fourier series in the interval  $(-\pi, \pi)$ . (05 Marks)
- b. Find the half range Fourier sine series of
- $$f(x) = \begin{cases} x & \text{in } 0 < x < 1 \\ 2-x & \text{in } 1 < x < 2 \end{cases} \quad (05 \text{ Marks})$$
- c. The following table gives the variation of a periodic current A over a period T.

t (sec)	0	T/6	T/3	T/2	2T/3	5T/6	T
A (amp)	1.98	1.3	1.05	1.3	-0.88	-0.25	1.98

Show that there is a constant part of 0.75 amp in the current A, and obtain the amplitude of the first harmonic. (06 Marks)

### Module-2

- 3 a. Find the Fourier transform of the function
- $$f(x) = \begin{cases} 1-|x| & \text{for } |x| \leq 1 \\ 0 & \text{for } |x| > 1 \end{cases} \quad (05 \text{ Marks})$$
- b. Find the z-transform of  $\left[ 3n - 4 \sin\left(\frac{n\pi}{4}\right) \right]$ . (05 Marks)
- c. Find inverse z-transform of  $\frac{20z^3 + 3z}{(5z-1)(5z+2)}$ . (06 Marks)

OR

- 4 a. Find the Fourier cosine transform of  $e^{-ax}$ . (05 Marks)
- b. Find the Fourier sine transform of the function
- $$f(x) = \begin{cases} x & \text{for } 0 < x < 1 \\ a-x & \text{for } 1 < x < a \\ 0 & \text{for } x > a \end{cases} \quad (05 \text{ Marks})$$

- c. Solve the difference equation  $u_{n+2} + 4u_{n+1} + 3u_n = 3^n$  with  $u_0 = 0 = u_1$  by z-transform method. (06 Marks)

**Module-3**

- 5 a. Find the coefficient of correlation for the following data:

x	1	2	3	4	5
y	2	5	3	8	7

(05 Marks)

- b. By the method of least squares, find the straight line that best fits to the following data in the form  $y = ax + b$ .

x	1	2	3	4	5
y	14	27	40	55	68

(05 Marks)

- c. Find the real root of the equation  $xe^x = \cos x$  that lies between 0.4 and 0.6, correct to 4 decimal places by Regula Falsi Method. (06 Marks)

**OR**

- 6 a. The equations of regression lines of two variables x and y are given by  $y = 0.516x + 33.73$  and  $x = 0.512y + 32.52$ , find  $\bar{x}$ ,  $\bar{y}$  and coefficient of correlation. (05 Marks)

- b. Fit a curve of the form  $y = ae^{bx}$  for the following data:

x	5	15	20	30	35	40
y	10	14	25	40	50	62

(05 Marks)

- c. Using Newton-Raphson method, find the real root of the equation  $e^x = 3x$  correct to 3 decimal places, taking initial approximate root  $x_0 = 0.5$ . (06 Marks)

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**Module-4**

- 7 a. Using Newton's backward interpolation formula, find the value of  $y(85)$  for the following data:

x	40	50	60	70	80	90
y	184	204	226	250	276	304

(05 Marks)

- b. For the following data, find x as a polynomial in y using the inverse Lagrange's interpolation formula:

x	2	10	17
y	1	3	4

Also, find x, given the value of  $y = 5$ .

(05 Marks)

- c. Evaluate  $\int_0^1 \frac{x}{1+x^2} dx$  by Simpson's  $1/3^{\text{rd}}$  rule by taking six equal parts. (06 Marks)

**OR**

- 8 a. Given  $f(40) = 184$ ,  $f(50) = 204$ ,  $f(60) = 226$ ,  $f(70) = 250$ ,  $f(80) = 276$ , find  $f(38)$  using Newton's forward interpolation formula. (05 Marks)

- b. If  $f(1) = 4$ ,  $f(3) = 32$ ,  $f(4) = 55$ ,  $f(6) = 119$ , find the interpolating polynomial by Newton's divided difference formula. (05 Marks)

- c. A curve is drawn to pass through the points given by the following table:

x	1	1.5	2	2.5	3	3.5	4
y	2	2.4	2.7	2.8	3	2.6	2.1

Using Weddle's rule, estimate the area bounded by the curve x-axis and the lines  $x = 1$  and  $x = 4$ . (06 Marks)

**Module-5**

- 9 a. Using Green's theorem, evaluate  $\int_C (2x^2 - y^2)dx + (x^2 + y^2)dy$ , where 'c' is the triangle formed by the lines  $x = 0$ ,  $y = 0$  and  $x + y = 1$ . (05 Marks)
- b. Using Stoke's theorem evaluate  $\int_C \vec{f} \cdot d\vec{r}$ , where  
 $\vec{f} = (y + z - 2x)\hat{i} + (z + x - 2y)\hat{j} + (x + y - 2z)\hat{k}$   
 and 'c' is the triangle with vertices  $(1, 0, 0)$ ,  $(0, 2, 0)$  and  $(0, 0, 3)$ . (05 Marks)
- c. State and prove Euler's equation. (06 Marks)

**OR**

- 10 a. Evaluate  $\iint_S \vec{F} \cdot \hat{n} ds$  where  $\vec{F} = 4xz\hat{i} - y^2\hat{j} + yz\hat{k}$  and 's' is the surface of the cube bounded by  $x = 0$ ,  $x = 1$ ,  $y = 0$ ,  $y = 1$ ,  $z = 0$ ,  $z = 1$ . (05 Marks)
- b. Find the curves on which the functional  $\int_0^1 [(y')^2 + 12xy]dx$ , with  $y(0) = 0$  and  $y(1) = -1$  can be extremised. (05 Marks)
- c. Show that the geodesics in a plane is straight line. (06 Marks)

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