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17MAT31

Third Semester B.E. Degree Examination, Dec.2019/Jan.2020 Engineering Mathematics – III

Time: 3 hrs.

Max. Marks: 100

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

Module-1

- 1 a. Find the Fourier series expansion of $f(x) = x$ in $(-7T, 7)$. hence deduce that
- $$\frac{n^2}{12} - \frac{1}{4^2} - \frac{1}{7^2} - \frac{1}{3^2} - \frac{1}{4^2} \dots \quad (08 \text{ Marks})$$
- b. Find the half range cosine series for the function $f(x) = (x - 1)^2$ in $0 < x < 1$. (06 Marks)
- c. Express y as a Fourier series upto first harmonics given :

x	0	60°	120°	180°	240°	300°
y	7.9	7.2	3.6	0.5	0.9	6.8

(06 Marks)

OR

- 2 a. Obtain the Fourier series for the function :

$$f(x) = \begin{cases} 1 + \frac{4x}{3} & \text{in } -\frac{3}{2} < x < 0 \\ \frac{4x}{3} & \text{in } 0 < x < \frac{3}{2} \end{cases}$$

Hence deduce that $\frac{1}{8} = \frac{1}{1^2} - \frac{1}{3^2} + \frac{1}{5^2} - \dots$

(08 Marks)

b. If $f(x) = \begin{cases} x & \text{in } 0 < x < \frac{\pi}{2} \\ \pi - x & \text{in } \frac{\pi}{2} < x < \pi \end{cases}$

Show that the half range sine series as

$$f(x) = \frac{4}{\pi} \left[\sin x - \frac{\sin 3x}{3^2} + \frac{\sin 5x}{5^2} - \dots \right]$$

(06 Marks)

- c. Obtain the Fourier series upto first harmonics given :

x	0	1	2	3	4	5	6
y	9	18	24	28	26	20	9

(06 Marks)

Module-2

- 3 a. Find the complex Fourier transform of the function :

$$f(x) = \begin{cases} 1 & \text{for } |x| < a \\ 0 & \text{for } |x| > a \end{cases} \quad \text{and hence evaluate } \int_0^{\infty} \frac{\sin x}{x} dx. \quad (08 \text{ Marks})$$

- b. Find the Fourier cosine transform of e^x . (06 Marks)

- c. Solve by using z - transforms $u_{n+2} - 4u_n = 0$ given that $u_0 = 0$ and $u_1 = 2$. (06 Marks)

OR

4 a. Find the Fourier sine and Cosine transforms of :

$$f(x) = \begin{cases} x & 0 < x < 2 \\ 0 & \text{elsewhere} \end{cases} \quad (08 \text{ Marks})$$

b. Find the Z — transform of : i) n^2 ii) ne^n . (06 Marks)

c. Obtain the inverse Z — transform of $\frac{2z^2 + 3z}{(z + 2)(z - 4)}$ (06 Marks)

Module-3

5 a. Obtain the lines of regression and hence find the co-efficient of correlation for the data :

x	1	3	4	2	5	8	9	10	13	15
y	8	6	10	8	12	16	16	10	32	32

(08 Marks)

b. Fit a parabola $y = ax^2 + bx + c$ in the least square sense for the data :

x	1	2	3	4	5
y	10	12	13	16	19

(06 Marks)

c. Find the root of the equation $xe^x - \cos x = 0$ by Regula — Falsi method correct to three decimal places in (0, 1). (06 Marks)

OR

6 a. If $8x - 10y + 66 = 0$ and $40x - 18y = 214$ are the two regression lines, find the mean of x's, mean of y's and the co-efficient of correlation. Find a_y if $a_x = 3$. (08 Marks)

b. Fit an exponential curve of the form $y = ae^{bx}$ by the method of least squares for the data :

No. of petals	5	6	7	8	9	10
No. of flowers	133	55	23	7	2	2

(06 Marks)

c. Using Newton—Raphson method, find the root that lies near $x = 4.5$ of the equation $\tan x = x$ correct to four decimal places. (06 Marks)

Module-4

7 a. From the following table find the number of students who have obtained marks :
 i) less than 45 ii) between 40 and 45.

Marks	30 — 40	40 — 50	50 — 60	60 — 70	70 — 80
No. of students	31	42	51	35	31

(06 Marks)

b. Using Newton's divided difference formula construct an interpolating polynomial for the following data :

x	4	5	7	10	11	13
f(x)	48	100	294	900	1210	2028

and hence find $g(8)$. (08 Marks)

c. Evaluate $\int_0^1 \frac{dx}{1+x^6}$ taking seven ordinates by applying Simpson's $\frac{1}{3}$ rule. (06 Marks)

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OR

- 8 a. In a table given below, the values of y are consecutive terms of a series of which 23.6 is the 6th term. Find the first and tenth terms of the series by Newton's formulas.

x	3	4	5	6	7	8	9
y	4.8	8.4	14.5	23.6	36.2	52.8	73.9

(08 Marks)

- b. Fit an interpolating polynomial of the form $x = f(y)$ for data and hence find $x(5)$ given :

x	2	10	17
y	1	3	4

(06 Marks)

- c. Use Simpson's ^{3rd} rule to find $\int_0^{0.6} e^{-x} dx$ by taking 6 sub-intervals.

(06 Marks)

Module-5

- 9 a. Verify Green's theorem in the plane for $\oint_C (3x^2 - 8y^2)dx + (4y - 6xy)dy$ where C is the closed curve bounded by $y = -x$ and $y = x^2$.

(08 Marks)

- b. Evaluate $\oint_C xy dx + xy^2 dy$ by Stoke's theorem where C is the square in the $x - y$ plane with vertices $(1, 0), (-1, 0), (0, 1), (0, -1)$.

(06 Marks)

- c. Prove that Catenary is the curve which when rotated about a line generates a surface of minimum area.

(06 Marks)

OR

- 10 a. If $F = 2xyz\mathbf{i} + yz^2\mathbf{j} + xz^2\mathbf{k}$ and S is the rectangular parallelepiped bounded by $x = 0, y = 0, z = 0, x = 2, y = 1, z = 3$ evaluate $\oint_S F \cdot d\mathbf{r}$.

(08 Marks)

Derive Euler's equation in the standard form viz $\frac{\partial}{\partial y} \left[\frac{\partial f}{\partial x} \right] - \frac{\partial}{\partial x} \left[\frac{\partial f}{\partial y} \right] = 0$.

(06 Marks)

- c. Find the external of the functional $I = \int_0^n (y'^2 - y'^2 - 2y \sin x) dx$ under the end conditions $y(0) = y(n/2) = 0$.

(06 Marks)