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15MAT31

Third Semester B.E. Degree Examination, Dec.2016/Jan.2017
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. Expand $f(x) = x - x^2$ as a Fourier series in the interval $(-\pi, \pi)$. (08 Marks)
b. Obtain the half-range cosine series for the function $f(x) = x(l - x)$ in the interval $0 \leq x \leq l$. (08 Marks)

OR

- 2 a. Obtain the Fourier series of $f(x) = \frac{\pi - x}{2}$ in $0 < x < 2\pi$. Hence deduce that

$$\frac{\pi}{4} = 1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \dots \quad (06 \text{ Marks})$$

- b. Find the half-range sine series for the function

$$f(x) = \begin{cases} \frac{1-x}{4} & \text{in } 0 < x < 1/2 \\ x - \frac{3}{4} & \text{in } 1/2 < x < 1 \end{cases} \quad (05 \text{ Marks})$$

- c. Compute the constant term and the coefficient of the 1st sine and cosine terms in the Fourier series of y as given in the following table:

x:	0	1	2	3	4	5
y:	4	8	15	7	6	2

(05 Marks)

Module-2

- 3 a. If $f(x) = \begin{cases} 1 - x^2; & |x| < 1 \\ 0; & |x| \geq 1 \end{cases}$. Find the Fourier transform of $f(x)$ and hence find the value of

$$\int_0^{\infty} \frac{x \cos x - \sin x}{x^3} dx. \quad (06 \text{ Marks})$$

- b. Find the Fourier sine and cosine transform of

$$f(x) = \begin{cases} x, & 0 < x < 2 \\ 0, & \text{elsewhere} \end{cases} \quad (05 \text{ Marks})$$

- c. Solve using Z-transform $y_{n+2} - 4y_n = 0$ given that $y_0 = 0, y_1 = 2$. (05 Marks)

OR

- 4 a. Obtain the inverse Fourier sine transform of $F_s(\alpha) = \frac{e^{-a\alpha}}{\alpha}, a > 0$. (06 Marks)

- b. Find the Z-transform of $2n + \sin\left(\frac{n\pi}{4}\right) + 1$. (05 Marks)

- c. If $U(z) = \frac{z}{z^2 + 7z + 10}$, find the inverse Z-transform. (05 Marks)

Module-3

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

x :	10	14	18	22	26	30
y :	18	12	24	6	30	36

(06 Marks)

- b. By the method of least square find the straight line that best fits the following data:

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

(05 Marks)

- c. Use Newton-Raphson method to find a root of the equation
- $\tan x - x = 0$
- near
- $x = 4.5$
- . Carry out two iterations. (05 Marks)

OR

- 6 a. Find the regression line of y on x for the following data:

x :	1	3	4	6	8	9	11	14
y :	1	2	4	4	5	7	8	9

Estimate the value of y when $x = 10$.

(06 Marks)

- b. Fit a second degree parabola to the following data:

x	0	1	2	3	4
y	1	1.8	1.3	2.5	6.3

(05 Marks)

- c. Solve
- $xe^x - 2 = 0$
- using Regula - Falsi method. (05 Marks)

Module-4

- 7 a. From the data given in the following table. Find the number of students who obtained less than 70 marks.

Marks :	0-19	20-39	40-59	60-79	80-99
Number of students :	41	62	65	50	17

(06 Marks)

- b. Find the equation of the polynomial which passes through the points (4, -43), (7, 83), (9, 327) and (12, 1053). Using Newton's divided difference interpolation. (05 Marks)

- c. Compute the value of
- $\int_{0.2}^{1.4} (\sin x - \log x + e^x) dx$
- using Simpson's
- $\frac{3}{8}$
- rule taking six parts. (05 Marks)

OR

- 8 a. Using Newton's backward interpolation formula find the interpolating polynomial for the function given by the following table:

x :	10	11	12	13
f(x) :	22	24	28	34

Hence find $f(12.5)$. (06 Marks)

- b. The following table gives the premium payable at ages in years completed. Interpolate the premium payable at age 35 completed. Using Lagrange's formula.

Age completed :	25	30	40	60
Premium in Rs. :	50	55	70	95

(05 Marks)

- c. Evaluate
- $\int_4^{5.2} \log_e x dx$
- taking 6 equal strips by applying Waddles rule. (05 Marks)

Module-5

- 9 a. Verify Green's theorem for $\oint (xy + y^2)dx + x^2dy$ where c is the closed curve of the region bounded by $y = x$ and $y = xz$. (06 Marks)
- b. Verify Stoke's theorem for $\vec{F} = (x^2 + y^2)\hat{i} - 2xy\hat{j}$ taken round the rectangle bounded by the lines $x = \pm a$, $y = 0$ and $y = b$. (05 Marks)
- c. A heavy cable hangs freely under gravity between two fixed points. Show that the shape of the cable is a catenary. (05 Marks)

OR

- 10 a. Use divergence theorem to evaluate $\iiint_S \vec{F} \cdot \hat{n} \, ds$ over the entire surface of the region above XoY plane bounded by the cone $z^2 = x^2 + y^2$, the plane $z = 4$ where $\vec{F} = 4xz\hat{i} + xyz^2\hat{j} + 3z\hat{k}$. (06 Marks)
- b. Find the extremal of the functional $\int_{x_1}^{x_2} [(y^1)^2 - y^2 + 2y \sec x] dx$. (05 Marks)
- c. Prove that the shortest distance between two points in a plane is along the straight line joining them. (05 Marks)

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