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15MAT31

Third Semester S.E. Degree Examination, June/July 2019

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 series for the function :

$$f(x) = \begin{cases} -\pi & \text{in } -T < x < 0 \\ x & \text{in } 0 < x < T \end{cases}$$

Hence deduce that $\sum_{n=1}^{\infty} \frac{1}{n^2} = \frac{\pi^2}{6}$

(08 Marks)

- b. Express y as a Fourier series up to the second harmonics, given :

x	0	$\pi/4$	$\pi/2$	$3\pi/4$	π	$5\pi/4$	$3\pi/2$
y	1.98	1.30	1.05	1.30	-0.88	-0.25	1.98

(08 Marks)

OR

- 2 a. Obtain the Fourier series for the function $f(x) = 2x - x^2$ in $0 < x < 2\pi$. (08 Marks)
 b. Obtain the constant term and the first two coefficients in the only Fourier cosine series for given data :

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

(08 Marks)

Module-2

- 3 a. Find the Fourier transform of e^{-ax} . (06 Marks)
 b. Find the Fourier sine transform of $\frac{e^{-ax}}{x}$, $a > 0$. (05 Marks)
 c. Obtain the z - transform of $\sin n\theta$ and $\cos n\theta$ (05 Marks)

OR

- 4 a. Find the inverse cosine transform of $F(a) = \begin{cases} -a, & 0 < a < 1 \\ 0, & a > 1 \end{cases}$

Hence evaluate $\int_0^{\pi} \frac{\sin^2 t}{t} dt$

(06 Marks)

- b. Find inverse Z - transform of $\frac{3z^2 + 2z}{(5z - 1)(5z + 2)}$ (05 Marks)

- c. Solve the difference equation $Y_{n+2} - 6Y_{n+1} + 9Y_n = 2^n$ with $y_0 = 0, y_1 = 0$, using z - transforms. (05 Marks)

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Module-3

- 5 a. Find the lines of regression and the coefficient of correlation for the data :

x	1	2	3	4	5	6	7
y	9	8	10	12	11	13	14

(06 Marks)

- b. Fit a second degree polynomial to the data :

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

(05 Marks)

- c. Find the real root of the equation $x \sin x + \cos x = 0$ near $x = \pi$, by using Newton — Raphson method upto four decimal places.

(05 Marks)

OR

- 6 a. in a partially destroyed laboratory record, only the lines of regression of y on x and x on y are available as $4x - 5y + 33 = 0$ and $20x - 9y = 107$ respectively. Calculate x, y and the coefficient of correlation between x and y.

(06 Marks)

- b. Fit a curve of the type $y = ae^{bx}$ to the data :

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

(05 Marks)

- c. Solve $\cos x = 3x - 1$ by using Regula — Falsi method correct upto three decimal places, (Carryout two approximations).

(05 Marks)

Module 4

- 7 a. Give $f(40) = 184$, $f(50) = 204$, $f(60) = 226$, $f(70) = 250$, $f(80) = 276$, $f(90) = 304$. Find $f(38)$ using Newton's forward interpolation formula.

(06 Marks)

- b. Find the interpolating polynomial for the data :

x	0	1	2	5
y	2	3	12	147

By using Lagrange's interpolating formula.

(05 Marks)

- c. Use Simpson's 8th rule to evaluate $\int_0^{0.3} (1-x)^3 dx$ considering 3 equal intervals.

(05 Marks)—

OR

- 8 a. The area of a circle (A) corresponding to diameter (D) is given below :

D	80	85	90	95	100
A	5026	5674	6362	7088	7854

Find the area corresponding to diameter 105, using an appropriate interpolation formula.

(06 Marks)

- b. Given the values :

x	5	7	11	13	17
g	150	392	1452	2366	5202

Evaluate $f(9)$ using Newton's divided difference formula.

(05 Marks)

- c. Evaluate $\int_0^1 \frac{1}{1+x^2} dx$ by Weddle's rule taking seven ordinates.

(05 Marks)

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Module-5

- 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 $x + y = 1$. (06 Marks)
- b. Verify Stoke's theorem for $f = (2x - y)i - yz^2j - y^2zk$ for the upper half of the sphere $x^2 + y^2 + z^2 = 1$. (05 Marks)
- c. Find the external of the functional $\int_{x_1}^{x_2} \{y^2 + (y')^2 + 2ye^x\} dx$ (05 Marks)

OR

- 10 a. Using Gauss divergence theorem, evaluate $\int_V \nabla \cdot f \, ds$, where $f = 4xzi - y^2j + yzk$ 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. A heavy cable hangs freely under the gravity between two fixed points. Show that the shape of the cable is a Catenary. (06 Marks)
- c. Find the external of the functional $\int_0^{\pi/2} \{y'^2 - y^2 + 4y \cos x\} dx$, give that $y = 0 = y(\pi/2)$. (05 Marks)

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