CBCS SCHEME

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15MAT31

Third Semester B.E. Degree Examination, Feb./Mar. 2022
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. Find the Fourier series for the function $f(x)=|x|$ in $(-\pi, \pi)$ and hence deduce that $\frac{\pi^2}{8}=\frac{1}{1^2}+\frac{1}{3^2}+\frac{1}{5^2}+.....$ **(08 Marks)**

b. Obtain the constant term and the coefficients of the first harmonics in the Fourier of y as given below:

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

(08 Marks)

OR

2 a. Obtain the Fourier series of the function
$$f(x)=\begin{cases} x, & \text{for } 0\le x\le \pi \\ 2\pi - x, & \text{for } \pi \le x\le 2\pi \end{cases}$$ **(06 Marks)**

b. Obtain a half-range cosine series for the function,
$$f(x)=\begin{cases} Kx, & 0\le x\le \frac{\ell}{2} \\ K(1-x), & \frac{\ell}{2}\le x\le \ell \end{cases}$$ **(05 Marks)**

c. Expand :
$$f(x)=\begin{cases} \frac{1}{4}-x, & \text{if } 0<x<\frac{1}{2} \\ x-\frac{3}{4}, & \text{if } \frac{1}{2}<x<1 \end{cases}$$ as the Fourier series of sine terms. **(05 Marks)**

Module-2

3 a. Find the Fourier transform of the function
$$f(x)=\begin{cases} 1, & \text{for } |x|\le a \\ 0, & \text{for } |x|>a \end{cases}$$ and hence evaluate $\int_0^{\pi/2}\frac{\sin x}{x}dx$ **(06 Marks)**

b. Find the Fourier sine transform of $e^{-|x|}$ and hence show that $\int_0^{\infty}\frac{x\sin mx}{1+x^2}dx=\frac{\pi}{2}e^{-m}$, $m>0$. **(05 Marks)**

c. Find the z-transform of (i) $(n+1)^2$ (ii) $\sin(3n+5)$ **(05 Marks)**

OR

4 a. Using z-transform, to solve $u_{n+2}+4u_{n+1}+3u_n=3^n$ with $u_0=0$, $u_1=1$. **(06 Marks)**

b. Find the inverse z-transform of $\frac{2z^2+3z}{(z+2)(z-4)}$. **(05 Marks)**

c. Obtain the Fourier cosine transform of

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

(05 Marks)

Module-3

5 a. Calculate the correlation coefficient of the following data:

x	105	104	102	101	100	99	98	96	93	92
y	101	103	100	98	95	96	104	92	97	94

(06 Marks)

b. Fit a curve $y = a + bx + cx^2$ for the following data:

x	0	1	2	3	4
y	1.0	1.8	1.3	2.5	6.3

(05 Marks)

c. Find the root of the equation $xe^x = \cos x$ using Regula-Falsi method. (05 Marks)

OR

6 a. Fit the curve $y = ae^{bx}$ for the following data:

x	2	4	6	8
y	25	38	56	84

(06 Marks)

b. Find by Newton's-Raphson method, the real root of the equation $3x = \cos x + 1$. (05 Marks)

c. Calculate the regression line y on x of the following data:

x	1	2	3	4	5	6	7	8	9	10
y	10	12	16	28	25	36	41	49	40	50

(05 Marks)

Module-4

7 a. Find the cubic polynomial which takes the following values:

x	0	1	2	3
f(x)	1	2	1	10

Hence evaluate f(4). (06 Marks)

b. Using Newton's divided difference formula, evaluate f(8) and f(15), given

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

(05 Marks)

c. Evaluate $\int_0^6 \frac{1}{1+x^2}dx$ by using Simpson's $1/3^{rd}$ rule. (05 Marks)

OR

8 a. Given the values

x	5	7	11	13	17
f(x)	150	392	1452	2366	5202

Evaluate f(9), using Lagrange's formula. (06 Marks)

b. Estimate the values of f(42) from the following data:

x	20	25	30	35	40	45
y	354	332	291	260	231	204

(05 Marks)

c. The following table gives the velocity v of a particle at time 't'.

t (sec)	0	2	4	6	8	10	12
v (n/sec)	4	6	16	34	60	94	136

Find the distance moved by the particle in 12 seconds and also the acceleration at $t = 2$ seconds. **(05 Marks)**

Module-5

9 a. Verify Green's theorem for $\int_c [(xy + y^2)dx + x^2 dy]$ where c is the bounded by $y = x$ and $y = x^2$. **(06 Marks)**

b. Applying Stoke's theorem to evaluate $\int_c (ydx + zdy + xdz)$ where c is the curve of intersection of $x^2 + y^2 + z^2 = a^2$ and $x + z = a$. **(05 Marks)**

c. Find the curves on which the functional $\int_0^1 [(y')^2 + 12xy]dx$ with $y(0) = 0$ and $y(1) = 1$ can be extremal. **(05 Marks)**

OR

10 a. Derive the Euler's equations in calculus of variation. **(06 Marks)**

b. Find the plane curve of fixed perimeter and maximum area. **(05 Marks)**

c. Evaluate $\int_s [yzi + zxj + xyk] \cdot ds$, where 's' is the surface of the sphere $x^2 + y^2 + z^2 = a^2$ in the first octant. **(05 Marks)**

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