B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

September / October 2023 Supplementary Examinations

Programme: B.E.   Semester: III
Branch: AS/CV/EEE/ECE/EIE/IEM/ME/MD/ETE   Duration: 3 hrs.
Course Code: 19MA3BSEM3   Max Marks: 100
Course: Engineering Mathematics-3   Date: 12.09.2023

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

UNIT - I

1. a) Test for consistency and solve the system of equations $x+2y+3z=14$; $4x+5y+7z=35$; $3x+3y+4z=21$. **6**

   b) Apply LU decomposition method to solve the system of equations $2x+y+4z=12$; $4x+11y-z=33$; $8x-3y+2z=20$. **7**

   c) Find all the eigenvalues and the corresponding eigenvectors of the matrix
   $A=\begin{bmatrix} 2 & 0 & 1 \\ 0 & 2 & 0 \\ 1 & 0 & 2 \end{bmatrix}$. **7**

UNIT - II

2. a) Obtain the complex form of the Fourier series for the periodic function
   $f(x)=\begin{cases} -k & \text{in } -\pi<x<0 \\ k & \text{in } 0<x<\pi \end{cases}$. **6**

   b) Obtain the Fourier series of the periodic function $f(x)=|x|$ in $(-\pi,\pi)$ and hence deduce that $\dfrac{\pi^2}{8}=\dfrac{1}{1^2}+\dfrac{1}{3^2}+\dfrac{1}{5^2}+\cdots\cdots$. **7**

   c) Obtain the Fourier series by neglecting the terms higher than first harmonics for the following data. **7**

$x°$	0	45	90	135	180	225	270	315
y	2	1.5	1	0.5	0	0.5	1	1.5

UNIT - III

3. a) Find the Fourier sine and cosine transform of the function $f(x)=e^{-ax}, a>0$. **6**

   b) Find the Fourier transform of $f(x)=\begin{cases} a^2-x^2 & \text{in } |x|\le a \\ 0 & \text{in } |x|>a \end{cases}$ and hence show that **7**
   $\displaystyle\int_0^\infty \frac{\sin x - x\cos x}{x^3}\, dx = \frac{\pi}{4}$.

c) Solve the integral equation $\int_0^\infty f(x)\cos(sx)dx = \begin{cases} 1-s & \text{in} \quad 0 \le s \le 1 \\ 0 & \text{in} \quad s > 1 \end{cases}$. Hence **7**

evaluate $\int_0^\infty \dfrac{1-\cos x}{x^2}dx$.

OR

4 a) Find the Fourier cosine transform of the function $f(x) = \begin{cases} 4x & \text{in} \quad 0 < x < 1 \\ 4-x & \text{in} \quad 1 < x < 4 \\ 0 & \text{in} \quad x > 4 \end{cases}$. **6**

b) Find the Fourier transform of $f(x) = e^{-a^2 x^2}$. Hence deduce that $e^{-x^2/2}$ is self - **7**
reciprocal with respect to Fourier transform.

c) Apply Parseval's identity for Fourier cosine transform to the functions $f(t) = e^{-at}$ **7**

and $g(t) = e^{-bt}$ to show that $\int_0^\infty \dfrac{dt}{(a^2+t^2)(b^2+t^2)} = \dfrac{\pi}{2ab(a+b)}$ where $a > 0, b > 0$.

UNIT - IV

5 a) Apply Lagrange's interpolation formula to find $f(2)$ for the following data **6**

x	1	3	4	6
y	4	40	85	2

b) Evaluate $\int_0^1 \dfrac{x}{1+x^2}dx$ by using Simpson's $\dfrac{1}{3}^{rd}$ rule by dividing the interval into **7**

six equal parts. Hence find an approximate value of $\log_e 2$.

c) Apply fourth order Runge-Kutta method to find y at $x = 0.1$ given that **7**
$\dfrac{dy}{dx} = 3e^x + 2y$, $y(0) = 0$ and $h = 0.1$.

UNIT - V

6 a) Find the Z- transform of i) $\cos(n\theta)$ ii) $\sin(n\theta)$. **6**

b) Find the extremal of the functional $\int_0^{\pi/2} \left[(y')^2 - y^2 + 4y\cos x \right] dx$ under the end **7**

conditions $y(0) = y\left(\dfrac{\pi}{2}\right) = 0$.

c) A uniform chain of fixed length l is freely suspended between two points so as to **7**
hang at rest under the action of gravity. Determine the shape of the curve.

OR

7 a) Find an extremal of the functional $\int_0^1 \sqrt{1+y'^2}\, dx$ under the end conditions $y(0) = 1$ and **6**

$y(1) = 2$.

b) Find the inverse Z-transform of $\dfrac{3z^2+z}{(5z-1)(5z+1)}$. **7**

c) Solve $u_{n+2} + 3u_{n+1} + 2u_n = 3^n$ with $u_0 = 0$ and $u_1 = 1$ using Z- transforms. **7**

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