U.S.N.										

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

Autonomous Institute Affiliated to VTU

January / February 2025 Semester End Main Examinations

Programme: B.E. **Semester: III**
Branch: AS/CV/EEE/ECE/EIE/IEM/ME/ML/TCE **Duration: 3 hrs.**
Course Code: 19MA3BSEM3 **Max Marks: 100**
Course: ENGINEERING MATHEMATICS – 3

Instructions: 1. All questions have internal choices.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - 1	*CO*	*PO*	**Marks**
1	a)	Solve the system of equations by LU factorization method $2x + y + 4z = 12;\ 8x - 3y + 2z = 20$ and $4x + 11y - z = 33$.	*1*	*1*	**6**
	b)	Solve the system of linear equations $9x + 2y + 4z = 20$, $x + 10y + 4z = 6$ and $2x - 4y + 10z = -15$ by Gauss-Seidel method with initial vector (1,0,0). Perform three iterations.	*1*	*1*	**7**
	c)	Determine the eigen values and eigen vectors of the matrix $\begin{bmatrix} 2 & 2 & 3 \\ 1 & 2 & 1 \\ 2 & -2 & 1 \end{bmatrix}$.	*1*	*1*	**7**
		OR			
2	a)	Find the rank of the matrix $\begin{bmatrix} 2 & -1 & -3 & -1 \\ 1 & 2 & 3 & -1 \\ 1 & 0 & 1 & 1 \\ 0 & 1 & 1 & -1 \end{bmatrix}$.	*1*	*1*	**6**
	b)	Solve the system of equations using Gauss Elimination method $2x + y + 3z = 1, 2x + 6y + 8z = 3$ and $6x + 8y + 18z = 6$.	*1*	*1*	**7**
	c)	Diagonalize the matrix $\begin{bmatrix} 1 & 6 & 1 \\ 1 & 2 & 0 \\ 0 & 0 & 3 \end{bmatrix}$.	*1*	*1*	**7**
		UNIT - 2			
3	a)	Obtain the Fourier series expansion of the periodic function $f(x) = x^3$ in the interval $(-\pi, \pi)$.	*2*	*1*	**6**
	b)	Expand the function $f(x) = \begin{cases} 1 + 2x & when -3 < x \le 0 \\ 1 - 2x & when \quad 0 \le x < 3 \end{cases}$ as a Fourier series	*2*	*1*	**7**
	c)	Obtain the constant term and first cosine and sine terms in the Fourier expansion of y from the following table: x: 0, 1, 2, 3, 4, 5 y: 9, 18, 24, 28, 26, 20	*2*	*1*	**7**

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

<table>
<tr><td></td><td></td><td></td><td>OR</td><td></td><td></td><td></td></tr>
<tr><td></td><td>4</td><td>a)</td><td>Find Fourier series for $f(x) = x^2, -\pi \le x \le \pi$.</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td></td><td></td><td>b)</td><td>Obtain the Fourier series expansion of the function
$f(x) = \begin{cases} x & in \quad 0 < x < \pi \\ x - 2\pi & in\, \pi < x < 2\pi \end{cases}$.</td><td>2</td><td>1</td><td>7</td></tr>
<tr><td></td><td></td><td>c)</td><td>Obtain the first two harmonics of the Fourier expansion of f(x) from the following table:
<table><tr><td>x</td><td>0</td><td>$\pi/3$</td><td>$2\pi/3$</td><td>π</td><td>$4\pi/3$</td><td>$5\pi/3$</td></tr><tr><td>f(x)</td><td>1.98</td><td>1.30</td><td>1.05</td><td>1.30</td><td>1.5</td><td>1.2</td></tr></table></td><td>2</td><td>1</td><td>7</td></tr>
<tr><td></td><td></td><td></td><td>UNIT - 3</td><td></td><td></td><td></td></tr>
<tr><td></td><td>5</td><td>a)</td><td>Find Fourier transform of $f(x) = \begin{cases} 1 - x^2 , & \lvert x \rvert < 1 \\ 0 , & \lvert x \rvert > 1 \end{cases}$.</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td></td><td></td><td>b)</td><td>Find Fourier cosine transform of $f(x) = e^{-ax}$, $(a > 0)$</td><td>2</td><td>1</td><td>7</td></tr>
<tr><td></td><td></td><td>c)</td><td>Prove that $\int_0^\infty \frac{dx}{(a^2+x^2)(b^2+x^2)} = \frac{2}{\pi ab(a+b)}$ using Parseval's identity.</td><td>2</td><td>1</td><td>7</td></tr>
<tr><td></td><td></td><td></td><td>OR</td><td></td><td></td><td></td></tr>
<tr><td></td><td>6</td><td>a)</td><td>Using Parseval's identity evaluate $\int_0^\infty \frac{dt}{(1+t^2)^2}$.</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td></td><td></td><td>b)</td><td>Find Fourier cosine transform of $f(x) = e^{-a^2x^2}$</td><td>2</td><td>1</td><td>7</td></tr>
<tr><td></td><td></td><td>c)</td><td>Find Fourier transform of $f(x) = \begin{cases} 1, & \lvert x \rvert < 1 \\ 0 , & \lvert x \rvert > 1 \end{cases}$.</td><td>2</td><td>1</td><td>7</td></tr>
<tr><td></td><td></td><td></td><td>UNIT - 4</td><td></td><td></td><td></td></tr>
<tr><td></td><td>7</td><td>a)</td><td>From the following table find the number of students who obtained marks between 40-45 using appropriate interpolation formula (correct to 3 decimal places).
<table><tr><td>Marks</td><td>30-40</td><td>40-50</td><td>50-60</td><td>60-70</td><td>70-80</td></tr><tr><td>No. of students</td><td>31</td><td>42</td><td>51</td><td>35</td><td>31</td></tr></table></td><td>1</td><td>1</td><td>6</td></tr>
<tr><td></td><td></td><td>b)</td><td>The velocity of a particle at a distance s from a point on its linear path is given by the following table:
<table><tr><td>s(m)</td><td>0</td><td>2.5</td><td>5</td><td>7.5</td><td>10</td><td>12.5</td><td>15</td><td>17.5</td><td>20</td></tr><tr><td>v(m/sec)</td><td>16</td><td>19</td><td>21</td><td>22</td><td>20</td><td>17</td><td>13</td><td>11</td><td>9</td></tr></table>Estimate the time taken by the particle to traverse the distance of 20m using Simpson's 3/8ths rule (correct to 3 decimal places).</td><td>1</td><td>1</td><td>7</td></tr>
<tr><td></td><td></td><td>c)</td><td>Given $\frac{dy}{dx} = e^x + y$, y(0) = 0 compute y (0.2) using Modified Euler's method correct to 3 decimal places.</td><td>1</td><td>1</td><td>7</td></tr>
<tr><td></td><td></td><td></td><td>OR</td><td></td><td></td><td></td></tr>
<tr><td></td><td>8</td><td>a)</td><td>Apply Newton-Raphson method to find $\sqrt[3]{37}$ correct to 3 decimal places.</td><td>1</td><td>1</td><td>6</td></tr>
</table>

<table>
<tr><td></td><td></td><td>b)</td><td>A body is in the form of a solid of revolution. The diameter D in cms of its cross section at a distance x cm from one end are given below. Estimate the volume of the solid (correct to 3 decimal places).
<table>
<tr><td>x</td><td>0</td><td>2.5</td><td>5</td><td>7.5</td><td>10</td><td>12.5</td><td>15</td></tr>
<tr><td>D</td><td>5</td><td>5.5</td><td>6</td><td>6.75</td><td>6.25</td><td>5.5</td><td>4</td></tr>
</table></td><td>1</td><td>1</td><td>7</td></tr>
<tr><td></td><td></td><td>c)</td><td>Apply Runge-Kutta method of order 4 to find $y(0.2)$ given that $\frac{dy}{dx} = 3x + \frac{y}{2}, y(0) = 1$ and $h = 0.2$ correct to 4 decimal places.</td><td>1</td><td>1</td><td>7</td></tr>
<tr><td></td><td></td><td></td><td>UNIT - 5</td><td></td><td></td><td></td></tr>
<tr><td></td><td>9</td><td>a)</td><td>Find Z-transform of $\left\{cos\left(\frac{n\pi}{2} + \frac{\pi}{4}\right)\right\}$.</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td></td><td></td><td>b)</td><td>Solve the difference equation $y_{n+2} - 5y_{n+1} + 6y_n = 6n$ if $y(0) = 0$ and $y(1) = 0$.</td><td>2</td><td>1</td><td>7</td></tr>
<tr><td></td><td></td><td>c)</td><td>Find the extremal of the functional integral $\int_{x_1}^{x_2}(1 + xy' + xy'^2)dx$.</td><td>3</td><td>1</td><td>7</td></tr>
<tr><td></td><td></td><td></td><td>OR</td><td></td><td></td><td></td></tr>
<tr><td></td><td>10</td><td>a)</td><td>Find the Z-transform of $\{sin(3\text{n} + 5)\}$.</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td></td><td></td><td>b)</td><td>Derive a Euler's equation in the form $\frac{\partial f}{\partial y} - \frac{d}{dx}\left(\frac{\partial f}{\partial y\prime}\right) = 0$.</td><td>2</td><td>1</td><td>7</td></tr>
<tr><td></td><td></td><td>c)</td><td>Find the geodesics on a surface given that the arc length on the surface is $s = \int_{x_1}^{x_2}\sqrt{x(1 + y'^2)}dx$.</td><td>3</td><td>1</td><td>7</td></tr>
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