U.S.N.										

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

Autonomous Institute Affiliated to VTU

October 2024 Supplementary Examinations

Program: B.E. **Semester: II**
Branch: AS / CH / CV / IEM / ME **Duration: 3 hrs.**
Course Code: 23MA2BSMCM / 22MA2BSMCV / 22MA2BSMME **Max Marks: 100**
Course:
Mathematical foundation for Civil and Mechanical Engineering stream – 2
Mathematical foundation for Civil Engineering – 2
Mathematical foundation for Mechanical Engineering Stream – 2

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
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.

			CO	*PO*	Marks
		UNIT - 1			
1	a)	Evaluate $\int_0^5 \int_0^{x^2} x(x^2+y^2)\,dydx$.	*1*	*1*	**6**
	b)	Evaluate $\int_0^\infty \int_0^\infty e^{-(x^2+y^2)}\,dx\,dy$ by changing the variables into polar coordinates.	*1*	*1*	**7**
	c)	Prove that $\int_0^{\frac{\pi}{2}} \frac{1}{\sqrt{sin\theta}} d\theta \times \int_0^{\frac{\pi}{2}} \sqrt{sin\theta}\,d\theta = \pi$.	*1*	*1*	**7**
		OR			
2	a)	Evaluate $\int_{-1}^{1} \int_0^{z} \int_{x-z}^{x+z} (x+y+z)\,dydxdz$.	*1*	*1*	**6**
	b)	Evaluate $\int_0^a \int_y^a \frac{x}{x^2+y^2} dxdy$ by changing the order of integration.	*1*	*1*	**7**
	c)	Express $\int_0^2 (4-x^2)^{\frac{3}{2}}\,dx$ in terms of the Beta function.	*1*	*1*	**7**
		UNIT – 2			
3	a)	Find the angle between the surfaces $x^2+y^2+z^2=9$ and $x^2+y^2-z=3$ at the point $(2,\ -1, 2)$.	*2*	*1*	**6**
	b)	Show that the vector field $\vec{F} = (x^2-y^2+x)\hat{\imath} - (2xy+y)\hat{\jmath}$ is an irrorational vector field and hence find scalar potential φ such that $\vec{F} = \nabla\varphi$.	*2*	*1*	**7**
	c)	Find the work done in moving a particle in the force field $\vec{F} = 3x^2\hat{\imath} + (2xz-y)\hat{\jmath} + z\hat{k}$ along the straight line from (0, 0, 0) to (2, 1, 3).	*2*	*1*	**7**
		UNIT – 3			
4	a)	Form the partial differential equation by eliminating arbitrary function from $\varphi(xy+z^2,\ x+y+z)=0$.	*1*	*1*	**6**
	b)	Solve $(mz-ny)\,p+(nx-lz)\,q=(ly-mx)$.	*1*	*1*	**7**

<table>
<tr><td></td><td></td><td>c)</td><td>Solve the partial differential equation $x^2 \frac{\partial u}{\partial x} + y^2 \frac{\partial u}{\partial y} = 0$ using the method of separation of variables.</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>5</td><td>a)</td><td>Form the partial differential equation by eliminating arbitrary constants from $z = xy + y\sqrt{x^2 - a^2} + b$.</td><td>1</td><td>1</td><td>6</td></tr>
<tr><td></td><td></td><td>b)</td><td>Solve $\left(x^2 - y^2 - z^2\right)p + 2xyq = 2xz$.</td><td>1</td><td>1</td><td>7</td></tr>
<tr><td></td><td></td><td>c)</td><td>Solve $\frac{\partial^3 z}{\partial x^2 \partial y} + 18xy^2 + \sin\left(2x - y\right) = 0$ by direct integration.</td><td>1</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>6</td><td>a)</td><td>Apply Newton - Raphson iterative method to find the real root of $x \log_{10} x = 1.2$ near $x = 2.5$ correct to four decimal places.</td><td>1</td><td>1</td><td>6</td></tr>
<tr><td></td><td></td><td>b)</td><td>Compute the approximate value of y for $x = 5$ by using appropriate Newton's interpolation for the following data:
<table><tr><td>x</td><td>4</td><td>6</td><td>8</td><td>10</td></tr><tr><td>y</td><td>1</td><td>3</td><td>8</td><td>16</td></tr></table></td><td>1</td><td>1</td><td>7</td></tr>
<tr><td></td><td></td><td>c)</td><td>Apply Lagrange's interpolation formula to find the value of y when $x = 10$, if the following values of x and y are given:
<table><tr><td>x</td><td>5</td><td>6</td><td>9</td><td>11</td></tr><tr><td>y</td><td>12</td><td>13</td><td>14</td><td>16</td></tr></table></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>7</td><td>a)</td><td>Apply Taylor series method to find the value of y at $x = 0.1$ given that $\frac{dy}{dx} = x - y^2$, $y(0) = 1$ taking terms up to fourth degree.</td><td>1</td><td>1</td><td>6</td></tr>
<tr><td></td><td></td><td>b)</td><td>Apply Modified Euler's method to compute y at $x = 0.1$ given $\frac{dy}{dx} = 3x + \frac{1}{2}y$ with $y(0) = 1$ taking $h = 0.1$. Perform three modifications.</td><td>1</td><td>1</td><td>7</td></tr>
<tr><td></td><td></td><td>c)</td><td>Find the approximate values of y at $x = 0.6$ by Runge-Kutta method given that $y = 0.41$ when $x = 0.4$ and $\frac{dy}{dx} = \sqrt{x + y}$ taking $h = 0.2$.</td><td>1</td><td>1</td><td>7</td></tr>
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