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

Autonomous Institute Affiliated to VTU

February / March 2025 Semester End Main Examinations

Programme: B.E. | **Semester: II**
Branch: ME, IEM, AS, CH, CV, EEE, ECE, MD, EIE, ETE | **Duration: 3 hrs.**
Course Code: 23MA2BSMCM /22MA2BSMME /22MA2BSMCV | **Max Marks: 100**
Course:
Mathematical Foundation for Civil and Mechanical Engineering Stream-2
Mathematical Foundation for Mechanical Engineering Stream – 2
Mathematical Foundation for Civil Engineering-2

Instructions:
1. All units have internal choice, answer one complete 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.

		UNIT - 1	***CO***	***PO***	**Marks**
1	a)	Evaluate $\int_{-1}^{1}\int_{0}^{z}\int_{x-z}^{x+z}(x+y+z)\,dy\,dx\,dz$.	*1*	*1*	**6**
	b)	Evaluate $\int_0^1\int_x^{\sqrt{x}} xy\,dydx$ by changing the order of integration.	*1*	*1*	**7**
	c)	Derive the relation between beta and gamma function in the form $\beta(m,n)=\frac{\Gamma(m)\Gamma(n)}{\Gamma(m+n)}$.	*1*	*1*	**7**
		OR			
2	a)	Evaluate $\int_0^\infty\int_0^\infty e^{-(x^2+y^2)}\,dx\,dy$ by changing into polar coordinates.	*1*	*1*	**6**
	b)	Find the volume of the tetrahedron bounded by the planes $x=0, y=0, z=0$ and $x+y+z=1$.	*1*	*1*	**7**
	c)	Prove that $\int_0^\infty x\,e^{-x^8}dx \times \int_0^\infty x^2e^{-x^4}dx = \frac{\pi}{16\sqrt{2}}$ using Beta and Gamma functions.	*1*	*1*	**7**
		UNIT - 2			
3	a)	Find the angle between surfaces $x^2+y^2+z^2=9$ and $x^2+y^2-z=3$ at the point $(2,-1,2)$.	*1*	*1*	**6**
	b)	Evaluate **div** $\vec{F}$ and **curl** $\vec{F}$ at the point $(1,2,3)$ given that $\vec{F}=x^2yz\hat{\imath}+xy^2z\hat{\jmath}+xyz^2\hat{k}$.	*1*	*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 $(2,1,3)$.	*1*	*1*	**7**
		OR			

	Q.No.		Question			Marks
	4	a)	Find the directional derivative of $f(x,y,z) = 4e^{2x+y+z}$ at the point $P = (1,1,-1)$ in the direction of $\overrightarrow{PQ}$ where $Q = (-3,5,6)$.	1	1	**6**
		b)	Find the value of a if the vector $\vec{F}$ has zero divergence, where $\vec{F} = (ax^2y + yz)\hat{\imath} + (xy^2 - xz^2)\hat{\jmath} + (2xyz - 2x^2y^2)\hat{k}$. Find the curl of the above vector which has zero divergence.	1	1	**7**
		c)	Apply Green's theorem to evaluate $\int_C (3x - 8y^2)dx + (4y - 6xy)\,dy$, where C is bounded by $x = 0, y = 0$ and $x + y = 1$.	1	1	**7**
			UNIT - 3			
	5	a)	Form a partial differential equation by eliminating arbitrary function ϕ from $\phi(x+y+z, x^2+y^2+z^2) = 0$.	1	1	**6**
		b)	Solve: $x^2(y-z)p + y^2(z-x)q = z^2(x-y)$.	1	1	**7**
		c)	Solve $x^2\frac{\partial u}{\partial x} + y^2\frac{\partial u}{\partial y} = 0$ by using the method of separation of variables.	1	1	**7**
			OR			
	6	a)	Solve $\frac{\partial^2 z}{\partial x \partial y} = x^2$ by direct integration method.	1	1	**6**
		b)	Form a partial differential equation by eliminating the arbitrary constants from $(x-a)^2 + (y-b)^2 = z$.	1	1	**7**
		c)	Derive the one-dimensional heat equation $\frac{\partial u}{\partial t} = c^2\frac{\partial^2 u}{\partial x^2}$.	1	1	**7**
			UNIT - 4			
	7	a)	Apply Newton-Raphson method to find a real root of $x^3 - 2x - 5 = 0$ near $x = 2.5$. Carryout 3 iterations.	1	1	**6**
		b)	Apply Lagrange's interpolation formula to compute $f(3)$ from the following data: x: 0, 1, 2, 5 $f(x)$: 2, 3, 12, 147	1	1	**7**
		c)	Evaluate $\int_0^6 \frac{1}{1+x^2}\,dx$ by Simpson's $\frac{3}{8}^{th}$ rule taking 7 ordinates.	1	1	**7**
			OR			
	8	a)	Apply Newton Raphson method to find an approximate root of the equation $x\,\log_{10} x = 1.2$ that is near 2.5. Carryout three iterations.	1	1	**6**
		b)	Find the number of students who have obtained marks between 40 and 45 from the given data: Marks: 0-40, 40-50, 50-60, 60-70, 70-80 No. of students: 31, 42, 51, 35, 31	1	1	**7**
		c)	Apply Simpson's 3/8th rule with $h = 0.2$, to find the approximate area under the curve $y = \frac{x^2-1}{x^2+1}$ between $x = 1$ and $x = 2.8$, by taking 6 equal subintervals.	1	1	**7**

			UNIT - 5			
	9	a)	Apply Taylor's series method to find y at $x = 0.1$ considering terms up to third degree, given that $\frac{dy}{dx} = x^2 + y^2$, $y(0) = 1$.	*1*	*1*	**6**
		b)	Apply fourth order Runge-Kutta method to find y at $x = 0.1$ given that $\frac{dy}{dx} = 3e^x + 2y$, $y(0) = 0$ taking $h = 0.1$.	*1*	*1*	**7**
		c)	Apply Milne's predictor-corrector method to find $y(0.4)$ correct to four decimal places given $\frac{dy}{dx} = x^2 + y^2$, $y(0) = 1.0000$, $y(0.1) = 1.1113$, $y(0.2) = 1.2507$ and $y(0.3) = 1.426$.	*1*	*1*	**7**
			OR			
	10	a)	Find $y(0.1)$ using Taylor's series method, given that $\frac{dy}{dx} = e^x - y^2$, $y(0) = 1$, considering terms up to 3rd degree.	*1*	*1*	**6**
		b)	Solve $y' = \log_e(x + y)$, $y(0) = 2$ at $x = 0.2$ using modified Euler's method. (Take $h = 0.2$). Perform two iterations.	*1*	*1*	**7**
		c)	Find an approximate solution of $\frac{dy}{dx} = 2e^x - y$ at $x = 0.4$ using Milne's predictor-corrector method given $y(0) = 2$, $y(0.1) = 2.010$, $y(0.2) = 2.04$ and $y(0.3) = 2.09$.	*1*	*1*	**7**

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