U.S.N.										

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

Autonomous Institute Affiliated to VTU

September 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.

			CO	PO	Marks
		UNIT - 1			
1	a)	Evaluate $\int_0^1 \int_x^{\sqrt{x}} xy\, dydx$.	1	1	**6**
	b)	Evaluate $\int_0^1 \int_0^{\sqrt{1-x^2}} y^2\, dy\, dx$ by changing the order of integration.	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)	Express $\int_0^{\infty} 4x^4 e^{-x^4} dx$ in terms of the Gamma function.	1	1	**6**
	b)	Find the area of the cardioid $r = a(1 + \cos\theta)$ using double integration.	2	1	**7**
	c)	Evaluate $\int_{-1}^{1} \int_0^z \int_{x-z}^{x+z} (x + y + z)\, dydxdz$.	1	1	**7**
		UNIT – 2			
3	a)	Find the directional derivative of $\varphi = x^2yz + 4xz^2$ at the point (1, -2, -1) in the direction of $2\hat{\imath} - \hat{\jmath} - 2\hat{k}$.	2	1	**6**
	b)	Evaluate $div\, \vec{F}$ and $curl\, \vec{F}$ at the point (1, 2, 3) given $\vec{F} = x^2yz\hat{\imath} + xy^2z\hat{\jmath} + xyz^2\hat{k}$.	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).	2	1	**7**
		UNIT – 3			
4	a)	Form a partial differential equation by eliminating arbitrary function from $\varphi\left(x + y + z,\, x^2 + y^2 + z^2\right) = 0$.	1	1	**6**
	b)	Solve $(y - z)p + (z - x)q = (x - y)$.	1	1	**7**

		c)	Solve $3\frac{\partial u}{\partial x}+2\frac{\partial u}{\partial y}=0$ by using method of separation of variables.	*1*	*1*	**7**
			OR			
	5	a)	Form the partial differential equation by eliminating arbitrary constants from $z=xy+y\sqrt{x^2-a^2}+b$.	*1*	*1*	**6**
		b)	Solve: $\frac{\partial^2 u}{\partial x^2}=x+y$ by direct integration method.	*1*	*1*	**7**
		c)	Derive the one-dimensional heat equation.	*2*	*1*	**7**
			UNIT - 4			
	6	a)	Apply Newton-Raphson iterative method to find the real root of $x^3-2x-5=0$ correct to three decimal places.	*1*	*1*	**6**
		b)	Apply Lagrange's formula to approximate $f(3)$ for data given below. x: 0, 1, 2, 5 $f(x)$: 2, 3, 12, 147	*1*	*1*	**7**
		c)	Evaluate $\int_0^1 \frac{1}{1+x^2}\,dx$ by applying Simpson's $\frac{3}{8}$ rule taking six equal subintervals.	*1*	*1*	**7**
			UNIT - 5			
	7	a)	Apply Taylor 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 Milne's predictor-corrector method to compute $y(0.8)$ given $\frac{dy}{dx}=x-y^2,\ y(0)=0,\ y(0.2)=0.02,\ y(0.4)=0.0795$ and $y(0.6)=0.1762$. Use the corrector formula once.	*1*	*1*	**7**
		c)	Apply fourth order Runge-Kutta method to find y at $x=0.1$ given that $\frac{dy}{dx}=3e^x+2y$, $y(0)=0$ and $h=0.1$.	*1*	*1*	**7**

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