U.S.N.										

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

Autonomous Institute Affiliated to VTU

December 2023 Supplementary Examinations

Programme: B.E. **Semester: I**
Branch: All Branches (Except IS/CS Clusters) **Duration: 3 hrs.**
Course Code: 22MA1BSMES/22MA1BSMCV/22MA1BSMME **Max Marks: 100**
Course: Mathematical Foundation for Electrical Stream-1
Mathematical Foundation for Civil Engineering -1
Mathematical Foundation for Mechanical Engineering Stream-1

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 - I			
1	a)	Find the Pedal equation of the curve $r^n = a^n \cos n\theta$.	CO1	PO1	**6**
	b)	If ϕ be the angle between the radius vector and the tangent at any point to the curve $r = f(\theta)$, then prove that $\tan\phi = r\dfrac{d\theta}{dr}$.	CO2	PO1	**7**
	c)	Show that the radius of curvature for the curve $y = 4\sin x - \sin 2x$ at $x = \dfrac{\pi}{2}$ is $\dfrac{5\sqrt{5}}{4}$.	CO2	PO1	**7**
		UNIT - II			
2	a)	If $z = e^{ax+by} f(ax-by)$, then prove that $b\dfrac{\partial z}{\partial x} + a\dfrac{\partial z}{\partial y} = 2abz$.	CO2	PO1	**6**
	b)	If $x = r\sin\theta\cos\phi$, $y = r\sin\theta\sin\phi$ and $z = r\cos\theta$, then find the Jacobian $\dfrac{\partial(x,y,z)}{\partial(r,\theta,\phi)}$.	CO1	PO1	**7**
	c)	Apply Maclaurin's theorem to expand $f(x,y) = e^x \log_e(1+y)$ in powers of x and y up to terms of third degree.	CO2	PO1	**7**
		OR			
3	a)	If $u = f(x+ay) + g(x-ay)$, then show that $\dfrac{\partial^2 u}{\partial y^2} = a^2 \dfrac{\partial^2 u}{\partial x^2}$.	CO1	PO1	**6**
	b)	If $u = f\left(xz, \dfrac{y}{z}\right)$, then prove that $x\dfrac{\partial u}{\partial x} - y\dfrac{\partial u}{\partial y} - z\dfrac{\partial u}{\partial z} = 0$.	CO1	PO1	**7**
	c)	Find the points on the surface $z^2 = xy + 1$ that are nearest to the origin.	CO1	PO1	**7**

			UNIT - III			
	4	a)	Solve the differential equation $\tan y \frac{dy}{dx} + \tan x = \cos y \cos^2 x$.	CO1	PO1	**6**
		b)	Solve the differential equation $(3x^2y^4 + 2xy)dx + (2x^3y^3 - x^2)dy = 0$.	CO1	PO1	**7**
		c)	Show that the family of curves $y^2 = 4a(x + a)$ is self-orthogonal.	CO2	PO1	**7**
			UNIT - IV			
	5	a)	Solve the differential equation $\left(x^4 - 2xy^2 + y^4\right)dx - \left(2x^2y - 4xy^3 + \sin y\right)dy = 0$.	CO1	PO1	**6**
		b)	Solve the differential equation $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + 2y = e^x \tan x$ using the method of variation of parameter.	CO1	PO1	**7**
		c)	Find the solution of the differential equation $x^2y'' + xy' + 9y = 3x^2 + \sin(3\log x)$.	CO1	PO1	**7**
			OR			
	6	a)	Solve the differential equation $\frac{d^3y}{dx^3} + \frac{d^2y}{dx^2} - 4\frac{dy}{dx} - 4y = 3e^{-x} - 4x - 6$.	CO1	PO1	**6**
		b)	Solve $\frac{d^2y}{dx^2} + 2\frac{dy}{dx} + y = e^{-2x} - \cos^2 x$.	CO2	PO1	**7**
		c)	Find the solution of the differential equation $(2x+1)^2y'' - 6(2x+1)y' + 16y = 8(2x+1)^2$.	CO1	PO1	**7**
			UNIT - V			
	7	a)	Solve the following system of equations by Gauss elimination method $w + x + y + z = 2,\ 2w - x + 2y - z = -5,$ $3w + 2x + 3y + 4z = 7$ and $w - 2x - 3y + 2z = 5$.	CO1	PO1	**6**
		b)	Apply the Gauss-Seidel iterative method to solve the system of equations $5x - y = 9, -x + 5y - z = 4, -2y + 5z = -6$. Carry out 3 iterations.	CO2	PO1	**7**
		c)	Apply Rayleigh's power method to find the largest eigenvalue and the corresponding eigenvector of the matrix $A = \begin{bmatrix} 4 & 1 & -1 \\ 2 & 3 & -1 \\ -2 & 1 & 5 \end{bmatrix}$ with initial eigenvector $\begin{bmatrix} 1 & 0 & 0 \end{bmatrix}^T$. Perform four iterations.	CO1	PO1	**7**

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