U.S.N.										

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

Autonomous Institute Affiliated to VTU

February / March 2025 Semester End Main Examinations

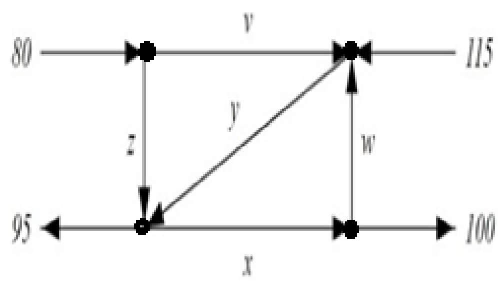
Programme: B.E. **Semester: I**
Branch: CS / IS / ML / CS-DS / AI-DS / CS - IOT / CSBS / BT **Duration: 3 hrs.**
Course Code: 23MA1BSMCS / 22MA1BSMCS **Max Marks: 100**
Course: Mathematical Foundation for Computer Science Stream -1

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)	Find the angle between the radius vector and the tangent to the curve $\frac{2a}{r} = 1 + \cos\theta$.	1	1	**6**
	b)	Find the pedal equation of the curve $r^m = a^m(\cos m\theta + \sin m\theta)$.	1	1	**7**
	c)	Compute the radius of curvature of the curve $\sqrt{x} + \sqrt{y} = 4$ at a point where it passes through origin making an angle 45 degrees with x-axis.	1	1	**7**
		OR			
2	a)	Prove that the curves $r = a(1 + \sin\theta)$ and $r = b(1 - \sin\theta)$ intersect each other orthogonally.	1	1	**6**
	b)	Compute the pedal equation of the curve $\frac{l}{r} = 1 + e\cos\theta$.	1	1	**7**
	c)	Find the radius of curvature of the curve $r = ae^{\theta\cot\alpha}$ where α, a are constants.	1	1	**7**
		UNIT - 2			
3	a)	If $f = \log(x^3 + y^3 + z^3 - 3xyz)$, then evaluate $\frac{\partial f}{\partial x} + \frac{\partial f}{\partial y} + \frac{\partial f}{\partial z}$.	1	1	**6**
	b)	Expand $f(x, y) = e^x \log(1 + y)$ as Maclaurin's series up to 2nd degree terms.	1	1	**7**
	c)	Apply Gradient descent method to approximate the minimum point of the function $f(x,y) = 3x^2 + y^2$ near the given point $(1,3)$. Perform three iterations.	2	1	**7**
		OR			
4	a)	If $u = F(x - y,\ y - z,\ z - x)$ then find $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z}$.	1	1	**6**
	b)	If $u = x - xy$, $v = xy$, then prove that $J \times J' = 1$.	1	1	**7**
	c)	Find the extreme values of the function $f(x, y) = x^3 + y^3 - 3x - 12y + 20$.	1	1	**7**

			UNIT – 3			
	5	a)	Solve: $xy' + y = x^5y^6$.	*1*	*1*	**6**
		b)	Solve: $(2xy + e^x)dx - \frac{e^x}{y}dy = 0$.	*1*	*1*	**7**
		c)	Find the orthogonal trajectories of the family $r^n = a^n \cos n\theta$.	*1*	*1*	**7**
			OR			
	6	a)	Solve: $y' + y\tan x = y^2 \sec x$.	*1*	*1*	**6**
		b)	Solve: $\frac{dy}{dx} = \frac{y^3-3x^2y}{x^3-3xy^2}$.	*1*	*1*	**7**
		c)	The number of bacteria N in a culture grew at a rate proportional to N. Initially there were 100 bacteria and increased to 332 in 1 hour. Estimate the number of bacteria N after 1.5 hours.	*2*	*1*	**7**
			UNIT - 4			
	7	a)	Solve the linear congruence $7x \equiv 2(\text{mod } 37)$.	*1*	*1*	**6**
		b)	Find the remainder when 11^{104} is divided by 17.	*1*	*1*	**7**
		c)	Apply Chinese remainder theorem to solve the system of linear congruences $x \equiv 2(\text{mod } 3)$, $x \equiv 3(\text{mod } 5)$ and $x \equiv 2(\text{mod } 7)$.	*1*	*1*	**7**
			OR			
	8	a)	Find the remainder when 94! is divided by 97.	*1*	*1*	**6**
		b)	Solve the linear Diophantine equation $6x + 9y = 21$.	*1*	*1*	**7**
		c)	There are certain things whose number is unknown. When this number is divided by 3 the remainder is 2, when divided by 5 the remainder is 3 and when divided by 7 the remainder is 2. What is the number of things?	*2*	*1*	**7**
			UNIT - 5			
	9	a)	Solve the system of equations $x + 2y + 3z = 1$, $2x + 3y + 8z = 2$ and $x + y + z = 3$ by Gauss elimination method.	*1*	*1*	**6**
		b)	Apply Gauss-Seidel iteration method to approximate the solution of the system of equations $27x + 6y - z = 85$, $6x + 15y + 2z = 72$ and $x + y + 54z = 110$ taking $(0, 0, 0)$ as the initial approximation. Perform 3 iterations.	*1*	*1*	**7**
		c)	Find all the eigenvalues and corresponding eigenvectors of the matrix $A = \begin{bmatrix} 1 & 1 & 3 \\ 1 & 5 & 1 \\ 3 & 1 & 1 \end{bmatrix}$.	*1*	*1*	**7**
			OR			
	10	a)	Find the value of k for which the system of equations $x + y + z = 1$, $2x + y + 4z = k$ and $4x + y + 10z = k^2$ is consistent. Hence solve them completely in each case.	*1*	*1*	**6**

		b)	Apply Rayleigh power method to compute the largest eigenvalue and corresponding eigenvector of the matrix $\begin{bmatrix} 2 & 0 & 1 \\ 0 & 2 & 0 \\ 1 & 0 & 2 \end{bmatrix}$ by taking initial eigenvector as $[1, 0, 0]^T$. Perform 4 iterations.	*1*	*1*	**7**
		c)	Consider the traffic flow problem given below.  i) Establish the system of linear equations. ii) Find the number of cars in each of the interior roads.	*2*	*1*	**7**

******