U.S.N.										

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

Autonomous Institute Affiliated to VTU

April 2025 Semester End Make-Up Examinations

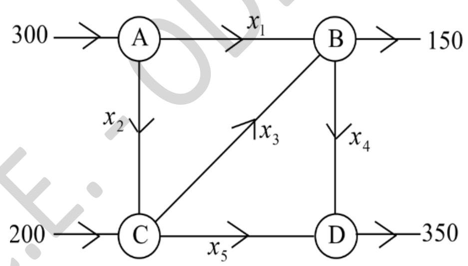
Programme: B.E. **Semester: I**
Branch: CS / IS / ML / CS-DS / AIDS /CS - IOT / CSBS / BT **Duration: 3 hrs.**
Course Code: 23MA1BSMCS / 22MA1BSMCS **Max Marks: 100**
Course: Mathematical foundation for Computer Science stream -1

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.

			CO	PO	Marks
		UNIT - 1			
1	a)	If ϕ be the angle between radius vector and the tangent at any point of the curve $r = f(\theta)$ then prove that $tan(\phi) = r\dfrac{d\theta}{dr}$.	1	1	**6**
	b)	Find the angle of intersection of the curves $r^2 \sin 2\theta = 4$ and $r^2 = 16\sin 2\theta$.	1	1	**7**
	c)	If ρ is the radius of curvature at any point P on the parabola $y^2 = 4ax$ and S is the focus then show that ρ^2 varies as $(SP)^3$.	1	1	**7**
		OR			
2	a)	Find the angle between the radius vector and the tangent for the curve $r\cos^2\left(\theta/2\right) = a^2$ and also find the slope of the tangent at the given point $\theta = 2\pi/3$.	1	1	**6**
	b)	Show that the radius of curvature ρ at any point on the curve $\theta = \dfrac{\sqrt{r^2 - a^2}}{a} - \cos^{-1}\left(\dfrac{a}{r}\right)$ is $\sqrt{r^2 - a^2}$.	1	1	**7**
	c)	Find the pedal equation of the curve $\dfrac{l}{r} = 1 + e\cos\theta$ at any point (r,θ).	1	1	**7**
		UNIT - 2			
3	a)	If $u = x^2 \tan^{-1}\left(\dfrac{y}{x}\right) - y^2 \tan^{-1}\left(\dfrac{x}{y}\right)$ then show that $\dfrac{\partial^2 u}{\partial x \partial y} = \dfrac{x^2 - y^2}{x^2 + y^2}$.	1	1	**6**
	b)	Verify $JJ' = 1$ for the given functions $u = \dfrac{yz}{x},\ v = \dfrac{zx}{y},\ w = \dfrac{xy}{z}$.	1	1	**7**

		c)	Assume that you are in charge of erecting a radio telescope on a newly discovered planet. To minimize interference, you want to place it where the magnetic field of the planet is weakest. The planet is spherical with a radius of 6 units. Based on a coordinate system whose origin is at the center of the planet; the strength of the magnetic field is given by $M(x,y,z)=6x-y^2+xz+60$. Where should you locate the radio telescope?	*2*	*1*	**7**
			OR			
	4	a)	Elevation of land above sea level, H, depends on two map coordinates (x,y) given by $H(x,y)=e^{-0.01(x^2+y^2)}$. A car travels through this terrain. So its coordinates depend on time as: $x(t)=-7+10\cos(10t)$, $y(t)=4+10\sin(10t)$. Find the speed with which the altitude of the car increases or decreases at $t=0$.	*2*	*1*	**6**
		b)	Expand the function $f(x,y)=x^2y+\sin y+e^x$ in powers of $(x-1)$ and $(y-\pi)$ up to second 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**
			UNIT - 3			
	5	a)	Solve: $\dfrac{dy}{dx}+\dfrac{y}{2x}=\dfrac{x}{y^3}, y(1)=2.$	*1*	*1*	**6**
		b)	Solve: $\left(xy^3+y\right)dx+2\left(x^2y^2+x+y^4\right)dy=0$.	*1*	*1*	**7**
		c)	Find the orthogonal trajectories of family of curves $r=a\left(1+\sin^2\theta\right)$.	*1*	*1*	**7**
			OR			
	6	a)	Solve: $\left(\dfrac{y}{(x+y)^2}-1\right)dx+\left(1-\dfrac{x}{(x+y)^2}\right)dy=0$.	*1*	*1*	**6**
		b)	Given $y=ce^{-2x}+3x$, find the member of its orthogonal trajectory which passes through the point $(0,3)$.	*1*	*1*	**7**
		c)	The population of a community is known to increase at a rate proportional to the number of people present at time *t*. An initial population P_0 has doubled in 5 years. Suppose it is known that the population of the community is 10000 after 3 years. What will the population be in 10 years? How fast is the population growing at $t=10$ years?	*2*	*1*	**7**
			UNIT - 4			
	7	a)	Find the number of mangoes remaining if we distribute 3^{247} mangoes equally among 17 fruit stalls.	*1*	*1*	**6**
		b)	Solve: $20x\equiv 8(\mathrm{mod}\ 24)$.	*1*	*1*	**7**

		c)	Priya keeps her pets in her backyard. If she divides them in 5 equal groups then 4 are left over. If she divides them in 8 groups, then 6 are left over and divides them in 9 groups, then 8 are left over. What is the smallest number of pets that Priya could have?	2	1	7
			OR			
	8	a)	Kiran wants to buy sandwich and cold coffee for his family. He has 400 rupees. If each sandwich is 57 Rs and each coffee is 22Rs. How many sandwiches and cold coffee can he buy?	2	1	6
		b)	Solve: $x^3 + x + 3 \equiv 0 \pmod{25}$.	1	1	7
		c)	Apply Fermat's Little theorem to show that 42 divides $n^7 - n$.	1	1	7
			UNIT - 5			
	9	a)	Investigate the values of a and b so that the equations $x + ay + z = 3$; $x + 2y + 2z = b$ and $x + 5y + 3z = 9$ have (i) no solution (ii) unique solution (iii) infinite number of solutions.	1	1	6
		b)	Apply Rayleigh power method to approximate the dominant eigenvalue and the corresponding eigenvector of the matrix $A = \begin{bmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 2 \end{bmatrix}$ by taking the initial vector as $[1 \quad 1 \quad 1]^T$. Perform four iterations.	1	1	7
		c)	The figure given below represents traffic entering and leaving the street junctions:  (i) Construct a mathematical model that describe the flow of traffic along various streets. (ii) What is the minimum flow theoretically possible along branch BD?	2	1	7
			OR			
	10	a)	Apply matrix method to balance the chemical equation $B_2S_3 + H_2O \rightarrow H_3BO_3 + H_2S$.	2	1	6
		b)	Apply Gauss-Seidel method to approximate the solution of the system of equations $x_1 - 8x_2 + 3x_3 = -4$; $2x_1 + x_2 + 9x_3 = 12$ and $8x_1 + 2x_2 - 2x_3 = 8$ by taking initial approximation as $(0,0,0)$. Perform three iterations.	1	1	7
		c)	Find the eigenvalues and the corresponding eigenvectors of the matrix $A = \begin{bmatrix} 1 & 1 & 3 \\ 1 & 5 & 1 \\ 3 & 1 & 1 \end{bmatrix}$.	1	1	7