CBCS SCHEME

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First Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026
Calculus and Linear Algebra : CSE Stream

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.
3. VTU Handbook is permitted.

		Module – 1	M	L	C
Q.1	a.	Find the total derivative when $u = x^3y^2 + x^2y^3$ where $x = at^2$, $y = 2at$	6	L2	CO1
	b.	If $u = \log(\tan x + \tan y + \tan z)$ then, show that $\sin 2x\frac{\partial u}{\partial x} + \sin 2y\frac{\partial u}{\partial y} + \sin 2z\frac{\partial u}{\partial z} = 2$	7	L2	CO1
	c.	Expand $e^x \sin y$ in the powers of x and y as far as terms of third term using Maclaurin's series.	7	L3	CO1
		OR			
Q.2	a.	If $u = x + y + z,\ v = x^2 + y^2 + z^2, w = xy + yz + zx$. Evaluate the Jacobian of (u, v, w) with respect to (x, y, z).	6	L2	CO1
	b.	If $u = f(\frac{x}{y}, \frac{y}{z}, \frac{z}{x})$ then prove that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} + z\frac{\partial u}{\partial z} = 0$	7	L2	CO1
	c.	Examine the function for the extreme values, given $f(x,y) = x^3 + 3xy^2 - 15x^2 - 15y^2 + 72x$	7	L3	CO1
		Module – 2			
Q.3	a.	Find the directional derivative of $\emptyset = x^2yz + 4xz^2$ at the point (1,-2,-1) in the direction $2\hat{i} - \hat{j} - 2\hat{k}$.	6	L2	CO1
	b.	Show that $\vec{F} = (y+z)\hat{i} + (z+x)\hat{j} + (x+y)\hat{k}$ is irrotational and find the scalar potential.	7	L2	CO1
	c.	With usual notation, Prove that cylindrical polar coordinate system is orthogonal.	7	L3	CO1
		OR			
Q.4	a.	Given $\vec{F} = \nabla(xy^3z^2)$, Find div$(\vec{F})$ and curl$(\vec{F})$ at (1,-1,1).	6	L2	CO1
	b.	Show that $\vec{F} = \frac{x\hat{i}+y\hat{j}}{x^2+y^2}$ is both solenoidal and irrotaional.	7	L2	CO1
	c.	Express $2y\hat{i} - z\hat{j} + 3x\hat{k}$ in terms of spherical polar coordinates.	7	L3	CO1

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		Module – 3	M	L	C
Q.5	a.	Find the rank of the matrix $A = \begin{bmatrix} 2 & 1 & -1 & 3 \\ 1 & 2 & 4 & 3 \\ 3 & 6 & 12 & 9 \\ 3 & 3 & 3 & 6 \end{bmatrix}$	6	L2	CO2
	b.	Using Gauss Jordan method, solve the system of equations $x + y + z = 9, x - 2y + 3z = 8,\ 2x + y - z = 3$.	7	L2	CO2
	c.	Diagonalize the matrix $\begin{bmatrix} -1 & 3 \\ -2 & 4 \end{bmatrix}$	7	L3	CO2
		OR			
Q.6	a.	Investigate the value of μ and λ such that the equations, $x + y + z = 6, x + 2y + 3z = 10, x + 2y + \lambda z = \mu$. may have (i) unique solution (ii) infinite solution (iii) no solution	6	L2	CO2
	b.	Using Gauss Elimination method, solve the system of equations $x + 2y + z = 3$, $2x + 3y + 3z = 10$, $3x - y + 2z = 13$	7	L2	CO2
	c.	Find the eigen value and eigen vectors of the matrix $A = \begin{bmatrix} 1 & 1 & 3 \\ 1 & 5 & 1 \\ 3 & 1 & 1 \end{bmatrix}$	7	L3	CO2
		Module – 4			
Q.7	a.	Determine whether the vectors (8,0,5) is a linear combination of the vectors (1,2,3), (0,1,4), (2,−1,1)	6	L2	CO3
	b.	Find the basis and dimension of the subspace spanned by the vectors (2,4,2), (1,−1,0), (1,2,1), (0,3,1) in $V_3(R)$	7	L2	CO3
	c.	Find the basis and dimension of the row space, column space and null space of the matrix $\begin{bmatrix} 1 & -1 & 1 & 3 & 2 \\ 2 & -1 & 1 & 5 & 1 \\ 0 & 1 & -1 & -1 & -3 \end{bmatrix}$	7	L3	CO3
		OR			
Q.8	a.	Find the coordinates of the vector v = (0,1,3) with respect to the basis B = {(1,1,0), (0,1,1), (1,0,1)}.	6	L2	CO3
	b.	Define inner product space. Given $u = (1,2,4), v = (2,-3,5), w = (4,2,-3)$ in R^3. Find (i) $\langle u,v \rangle$ (ii) $\langle v,w \rangle$ (iii) $\langle u,w \rangle$ (iv) $\|u\|$ (v) $\|v\|$	7	L2	CO3
	c.	What is a subspace? Prove that the subset W = {(x, y, z)/x − 3y + 4z = 0} of the vector space R^3 is a subspace.	7	L3	CO3
		Module – 5			
Q.9	a.	Show that the transformation $T: R^2 \to R^3$ defined by $T(x,y) = (x+y,\ x-y,\ y)$ is a linear transformation.	6	L2	CO3