Reg. No.															

Question Paper Code	13789

B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2025

First Semester

Civil Engineering

(Common to All Branches)

24BSMA101 - MATRICES AND CALCULUS

Regulations - 2024

Duration: 3 Hours | Max. Marks: 100

PART - A (MCQ) (10 × 1 = 10 Marks)

Answer ALL Questions

		Marks	K – Level	CO
1.	The Cayley-Hamilton theorem states that every square matrix satisfies its ______________ (a) Characteristic equation (b) Minimal polynomial (c) Inverse matrix (d) Eigenvector equation	1	K1	CO1
2.	The determinant of an orthogonal matrix is always: (a) 0 (b) 1 or -1 (c) Positive (d) Negative	1	K1	CO1
3.	If $x = r\cos\theta, y = r\sin\theta$ then the value of $\frac{\partial(x,y)}{\partial(r,\theta)}$ is equal to (a) θ (b) $-\theta$ (c) r (d) -r	1	K1	CO2
4.	For function $f(x,y)$ to have minimum value at (a,b)value is? (a) $rt - s^2 > 0$ and $r < 0$ (b) $rt - s^2 > 0$ and $r > 0$ (c) $rt - s^2 < 0$ and $r < 0$ (d) $rt - s^2 < 0$ and $r > 0$	1	K1	CO2
5.	If $\vec{F} = x\vec{i} + y\vec{j} + z\vec{k}$, what is the value of $\nabla . F$. (a) x+y+z (b) 3 (c) 1 (d) 0	1	K2	CO3
6.	A vector field with zero curl is called________________________ (a) Solenoidal (b) Irrotational (c) Conservative (d) Both b and c	1	K1	CO3
7.	Green's theorem relates____ (a) A line integral around a simple closed curve C to a double integral over the region R it encloses (b) A surface integral to a volume integral (c) A curl to a divergence (d) None of the above	1	K1	CO4
8.	Stokes' theorem relates____ (a) A surface integral of curl F over surface S to the line integral of F along the boundary curve C (b) A volume integral to a surface integral (c) Gradient to divergence (d) None of the above	1	K1	CO4
9.	What is the area enclosed by the curve r = 2cosθin polar coordinates? (a) π (b) π/2 (c) 2π (d) 4π	1	K2	CO5
10.	The convergence of the Fourier series is guaranteed by (a) Dirichlet's conditions (b) Mean value theorem (c) Fundamental theorem of calculus (d) Fourier Integral theorem	1	K1	CO6

PART - B (12 × 2 = 24 Marks)

Answer ALL Questions

11.	The product of two eigenvalues of the matrix A= $\begin{bmatrix} 6 & 2 & 2 \\ 2 & 3 & 1 \\ 2 & 1 & 3 \end{bmatrix}$ is 16. Find the third eigenvalue of A.	2	K2	CO1
12.	Find the nature of quadratic form $2xy + 2yz + 2zx$.	2	K2	CO1

13.		Find. $\lim_{(x,y)\to(0,0)} \left[\frac{x^2 y}{x^4+y^2}\right]$	2	K2	CO2
14.		If $x = r\cos\theta, y = r\sin\theta$, then find $\frac{\partial(x,y)}{\partial(r,\theta)}$.	2	K2	CO2
15.		Prove that $F = (4x+z^2)\vec{i} + (6x^2+z)\vec{j} + (3yz^2+y)\vec{k}$ is solenoidal.	2	K2	CO3
16.		Find the constant a such that $(3x-2y+z)\vec{i} + (4x+ay-z)\vec{j} + (x-y+2z)\vec{k}$ is solenoidal.	2	K2	CO3
17.		Find the area of the circle of radius 'a' using Green'stheorem.	2	K2	CO4
18.		State Stoke's theorem.	2	K1	CO4
19.		Evaluate $\int_0^1\int_1^2 x(x+y)\,dydx$.	2	K2	CO5
20.		Evaluate $\int_0^{\frac{\pi}{2}}\int_0^{\sin\theta} r\,d\theta\,dr$.	2	K2	CO5
21.		Find half range sine series for $f(x) = k \text{ in } 0 < x < \pi$.	2	K2	CO6
22.		State the Dirichlet's conditions for the existence of the Fourier expansion of f(x), in the interval (0, 2π).	2	K1	CO6

PART - C (6 × 11 = 66 Marks)

Answer ALL Questions

23.	a)	Using Cayley-Hamilton theorem find A^4 and A^{-1} when $A = \begin{pmatrix} 2 & -1 & 2 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{pmatrix}$.	11	K3	CO1
		OR			
	b)	Reduce the quadratic form $3x^2+5y^2+3z^2-2yz+2zx-2xy$ into canonical form by an orthogonal transformation.	11	K3	CO1
24.	a)	Expand $e^x\cos y$ in powers of $x \,\&\, y$ as far as the terms of the third degree using Taylor's series method.	11	K3	CO2
		OR			
	b)	The temperature $u(x,y,z)$ at any point in space is $u = 400xyz^2$. Find the highest temperature on surface of the sphere $x^2+y^2+z^2=1$.	11	K3	CO2
25.	a)	Prove that $\vec{F} = (6xy+z^3)\,\vec{i} + (3x^2-z)\,\vec{j} + (3xz^2-y)\,\vec{k}$ is irrotational and find its scalar potential.	11	K3	CO3
		OR			
	b)	Find a and b so that the surfaces $ax^2-byz=(a+2)x$ and $4x^2y+z^3=4$ cut orthogonally at the point $(1,\ -1,\ \ 2)$.	11	K3	CO3
26.	a)	Verify Stoke's theorem for $\vec{F} = (x^2+y^2)\vec{i} - 2\,xy\,\vec{j}$ taken round the rectangle bounded by the lines $x = \pm a, y = 0, y = b$.	11	K3	CO4
		OR			
	b)	Verify Gauss Divergence theorem for $\vec{F} = (x^2-yz)\vec{i} + (y^2-zx)\,\vec{j} + (z^2-xy)\vec{k}$ taken over the rectangular parallelopiped bounded by $x=0,\ y=0,\ z=0$ and $x=a, y=b,\ z=c$.	11	K3	CO4
27.	a)	Evaluate by changing the order of integration $\int_0^{4a}\int_{\frac{x^2}{4a}}^{2\sqrt{ax}} dydx$.	11	K3	CO5
		OR			

	b)	Find the volume of the sphere $x^2 + y^2 + z^2 = a^2$ using triple integrals.	*11*	*K3*	*CO5*
28.	a)	If $f(x) = \frac{1}{2}(\pi - x)$, find the Fourier series of period 2π in the interval $(0,2\pi)$. Hence deduce that $1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \ldots = \frac{\pi}{4}$.	*11*	*K3*	*CO6*
		OR			
	b)	Find the Fourier series of the function $f(x) = x^2$ in the interval $-\pi < x < \pi$. Hence deduce that using Parseval's theorem $\frac{1}{1^4} + \frac{1}{2^4} + \frac{1}{3^4} + ... = \frac{\pi^4}{90}$.	*11*	*K3*	*CO6*

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create