Reg. No.																

Sri SAI RAM ENGINEERING COLLEGE

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Question Paper Code	14203

B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2025

First Semester

Civil Engineering

(Common to All Branches except CSBS)

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.	If A is orthogonal matrix, if $(a) A^T = A$ (b) $A^T = A^{-1}$ (c) A=I (d) AA^T=0	1	K1	CO1
2.	If A is real symmetric matrix, then its eigenvalues are (a) Always positive (b) Always real (c) Always imaginary (d) Always zero	1	K2	CO1
3.	The necessary condition for maxima and minima of a function f(x. y) is $(a) f_x = 0$ (b) $f_{yy} = 0$ (c) $f_x = 0$ and $f_y = 0$ (d) $f_{xx} = 0$	1	K1	CO2
4.	If $x = r\cos\theta$ and $y = r\sin\theta$, then the Jacobian $\frac{\partial(x,y)}{\partial(r,\theta)}$ (a) -x (b) r (c) y (d) xy	1	K2	CO2
5.	If $\nabla.\vec{F} = 0$, the field is (a) Rotational (b) Divergent (c) Solenoidal (d) Irrotational	1	K1	CO3
6.	Which theorem relates surface integral to volume integral? (a) Stoke's (b) Gauss divergence (c) Green's (d) Cauchy's	1	K1	CO3
7.	In polar coordinate, then area element dA= (a) dxdy (b) rdrdθ (c) drdθ (d) xydxdy	1	K1	CO4
8.	The Divergence theorem relates which two types of integrals (a) Line and surface (b) surface and volumr (c) line and volume (d) scalar and vector	1	K1	CO4
9.	Triple integrals are used to find (a) Gradient (b) Curve length (c) Area (d) Volume	1	K1	CO5
10.	Parseval's theorem gives a relation between (a)Time and frquency domain energies (b) Amplitude and phase (c) Area (d) None	1	K1	CO6

PART - B (12 × 2 = 24 Marks)

Answer ALL Questions

11.	If the matrix $A = \begin{bmatrix} 2 & 0 & 0 \\ 0 & 3 & 0 \\ 0 & 0 & 4 \end{bmatrix}$ find the eigenvalues of A^2.	2	K2	CO1
12.	State Cayley Hamilton Theorem.	2	K1	CO1
13.	Find the stationary points of the function $f(x, y) = x^3 + y^3 - 12x - 3y + 20$.	2	K2	CO2
14.	If $u = x + y , v = x - y$ evaluate the jacobian of $\frac{\partial(u,v)}{\partial(x,y)}$.	2	K2	CO2
15.	Find 'a' such that $(3x - 2y + z)\vec{i} + (4x + ay - z)\vec{j} + (x - y + 2z)\vec{k}$ is solenoidal.	2	K2	CO3

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

16.	Prove that $\nabla \times \vec{r} = 0$.	2	K2	CO3
17.	State Stoke's theorem.	2	K1	CO4
18.	If $\vec{F} = x^2\vec{i} + xy^2\vec{j}$, evaluate the line integral $\int_c \vec{F}.d\vec{r}$ from $(0,0)$ to $(1,1)$ along the path y=x.	2	K2	CO4
19.	Evaluate $\int_0^1 \int_1^2 x(x+y)\,dydx$.	2	K2	CO5
20.	Evaluate $\int_0^1 \int_0^2 \int_0^3 xyzdzdydx$.	2	K2	CO5
21.	State Dirichlet's conditions.	2	K1	CO6
22.	Find b_n in the expansion of x^2 as a Fourier Series in $(-\pi, \pi)$.	2	K2	CO6

PART - C (6 × 11 = 66 Marks)

Answer ALL Questions

23.	a)	Verify Cayley -Hamilton theorem for $A = \begin{bmatrix} 1 & 0 & 3 \\ 2 & 1 & -1 \\ 1 & -1 & 1 \end{bmatrix}$ and hence find A^{-1}.	11	K3	CO1
		OR			
	b)	Reduce the quadratic form $x^2 + y^2 + z^2 - 2xy - 2yz - 2zx$ to canonical form through an orthogonal transformation.	11	K3	CO1
24.	a)	Expand $e^x cosy$ about $\left(0, \frac{\pi}{2}\right)$ up to the third term using Taylor's series.	11	K3	CO2
		OR			
	b)	A rectangular box open at the top, is to have a volume of 32 cc. Find the dimensions of the box, that requires the least material for its construction.	11	K3	CO2
25.	a)	Show that $\vec{F} = (6xy + z^3)\vec{i} + (3x^2 - z)\vec{j} + (3xz^2 - y)\vec{k}$ is irrotational vector and find the scalar potential function.	11	K3	CO3
		OR			
	b)	Show that $r^n\vec{r}$ is an irrotational vector for any value of n but is solenoidal only if $n = -3$.	11	K3	CO3
26.	a)	Using Green's theorem evaluate $\int_c \{(xy + y^2)dx + x^2dy\}$, where C is he closed of the region bounded by y=x and $y = x^2$.	11	K3	CO4
		OR			
	b)	Verify divergence theorem for $\vec{F} = x^2\vec{i} + z\vec{j} + yz\vec{k}$ over the cube formed by the plane x=0, x=1, y=0, y=1, z=0, z=1.	11	K3	CO4
27.	a)	Change the order of integration and hence evaluate it $\int_0^{4a} \int_{\frac{x^2}{4a}}^{2\sqrt{ax}} dydx$.	11	K3	CO5
		OR			
	b)	Find the volume of the ellipsoid $\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$ by using triple integrals.	11	K3	CO5
28.	a)	Find the Fourier series of the function $f(x) = x^2$ in the interval $(0, 2\pi)$.	11	K3	CO6
		OR			
	b)	Find the cosine series for $f(x) = x$ in $(0, \pi)$ and then using Parseval's theorem. Hence show that $1 + \frac{1}{3^4} + \frac{1}{5^4} + \ldots = \frac{\pi^4}{96}$.	11	K3	CO6