Reg. No.																

Question Paper Code	13331

B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2024 (JAN - 2025)

First Semester

Civil Engineering

(Common to All Branches Except CSBS)

24BSMA101 - MATRICES AND CALCULUS

Duration: 3 Hours | Max. Marks: 100

PART - A (MCQ) (20 × 1 = 20 Marks)

Answer ALL Questions

No.	Question	Marks	K – Level	CO
1.	Given A= $\begin{pmatrix} -1 & 0 & 0 \\ 2 & -3 & 0 \\ 1 & 4 & 2 \end{pmatrix}$ Then eigen values of A^2 are (a)1,9,9 (b)1,1/9/1/4 (c)-1, -3,2 (d)1,9,4	1	K2	CO1
2.	When a quadratic form is reduced to its canonical form using orthogonal transformations, which of the following is true? (a) The transformation matrix is non symmetric (b) The transformation matrix is always diagonal (c) The transformation preserves the nature of the quadratic form (positive definite, negative definite, etc.) (d) The transformation changes the nature of the quadratic form	1	K2	CO1
3.	A matrix 'A' is orthogonal if ______ (a) $A^T=A$ (b) $A^TA=I$ (c) A is symmetric (d) $A^2=I$	1	K1	CO1
4.	If a quadratic form has the canonical form $x_1^2 + x_2^2 - 2x_3^2$, what is the nature of the quadratic form? (a) Positive definite (b) Negative definite (c) Indefinite (d) Semi-definite	1	K2	CO1
5.	For the function $f(x, y)$ to have maximum value at (a, b) (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	K3	CO2
6.	If u, v are functions of x, y and x, y are functions of r, s then Jacobian of u, v with respect to r, s is (a) $\frac{\partial(x,y)}{\partial(u,v)} \cdot \frac{\partial(x,y)}{\partial(r,s)}$ (b) $\frac{\partial(u,v)}{\partial(x,y)} \cdot \frac{\partial(x,y)}{\partial(r,s)}$ (c) 1 (d) 0	1	K1	CO2
7.	What is the saddle point? (a) Point where function has maximum value (b) Point where function has minimum value (c) Point where function has zero value (d) Point where function neither have maximum value nor minimum value.	1	K2	CO2
8.	Which of the following statements is true for a function with a local maximum at (x_0,y_0)? (a) $f_x(x_0,y_0)=f_y(x_0,y_0)=0$ and the second partial derivatives are negative (b) $f_x(x_0,y_0)=f_y(x_0,y_0)=0$ and the second partial derivatives are positive (c) $f_x(x_0,y_0)=0$, $f_y(x_0,y_0)=0$, and the function is concave down (d) The first partial derivatives do not exist at (x_0,y_0)	1	K1	CO2

9. A vector field is said to be irrotational if _____. — 1 K1 CO3
(a) Its curl is zero everywhere
(b) Its divergence is zero everywhere
(c) Its divergence and curl are both zero everywhere
(d) Its gradient is zero everywhere

10. Which of the following vector fields is solenoidal? — 1 K1 CO3
(a) A vector field with curl zero and divergence zero
(b) A vector field that can be expressed as the gradient of a scalar function
(c) A vector field whose divergence is zero
(d) A vector field whose curl is non-zero everywhere

11. If C is a simple closed curve and $\vec{F}$ is conservative, then $\int_C \vec{F}\,.\overrightarrow{dr} =$ — 1 K2 CO4
(a) $\Phi(A) - \Phi(B)$ (b) $\Phi(A) + \Phi(B)$ (c) $\Phi(B) - \Phi(A)$ (d) 0

12. If F is a scalar point function the $curl\ grad\ F =$ — 1 K3 CO4
(a) 0 (b) $\nabla^2 f$ (c) F (d) ∇f

13. Changing the order of integration in the double integral based on _____ — 1 K2 CO5
(a) Variables (b) Function (c) Region (d) Order

14. If R is the region bounded x = 0, y = 0, x + y = 1 then $\iint_R dxdy$ is equal to ___ — 1 K2 CO5
(a) 1 (b) 1/ 2 (c) 1 / 3 (d) 2 / 3

15. $\int_0^1 \int_0^1 xydxdy =$ ___ — 1 K2 CO5
(a) 0 (b) 1 (c) 1 / 2 (d) 1 / 4

16. $\int_0^1 \int_0^2 \int_0^3 dxdydz =$ ___ — 1 K2 CO5
(a) 3 (b) 4 (c) 5 (d) 6

17. The Convergence of the Fourier series is guaranteed by — 1 K3 CO6
(a) Dirichlet's conditions (b) Mean value theorem
(c) Fundamental theorem of calculus (d) Fourier Integral theorem

18. If the function *f(x)* is even, then which of the following Fourier constant is zero? — 1 K2 CO6
(a) a_0 (b) a_n (c) b_n (d) nothing is zero

19. If the function *f(x)* is odd, then which of the only coefficient is present? — 1 K2 CO6
(a) a_0 (b) a_n (c) b_n (d) everything is present.

20. A "periodic function" is given by a function which _____? — 1 K2 CO6
(a) has a period $T = 2\pi$
(b) Satisfies $f(t + T) = f(t)$
(c) Satisfies $f(t + T) = - f(t)$
(d) has a period $T = \pi$

PART - B (10 × 2 = 20 Marks)
Answer ALL Questions

21. State the Cayley - Hamilton theorem. — 2 K1 CO1

22. Find the sum and product of the Eigen values of the matrix $A = \begin{bmatrix} 1 & 2 & 5 \\ 2 & 3 & 4 \\ 3 & 6 & 7 \end{bmatrix}$. — 2 K2 CO1

23. Evaluate $\lim_{x \to 2} \frac{x^2-4}{x-2}$. — 2 K2 CO2

24. State the sufficient conditions for $f(x, y)$ to be maximum or minimum. — 2 K1 CO2

25. Find the unit normal vector to the surface $x^2+y^2=z$ at (1,-2,5). — 2 K2 CO3

26. State Green's Theorem. — 2 K1 CO4

27.	Transform into polar coordinates in the integral $\int_0^a \int_y^a f(x,y)\,dx\,dy$.	2	K2	CO5
28.	Evaluate $\int_0^{\pi}\int_0^{\cos\theta} r\,dr\,d\theta$.	2	K2	CO5
29.	State the Dirichlet's conditions.	2	K1	CO6
30.	Find b_n in the expansion of $f(x) = x^2$ as a Fourier series in $(-\pi,\pi)$.	2	K2	CO6

PART - C (6 × 10 = 60 Marks)

Answer ALL Questions

31.	a)	Find the Eigen values and Eigen vectors of the matrix $A=\begin{bmatrix} 2 & 2 & 0 \\ 2 & 1 & 1 \\ -7 & 2 & -3 \end{bmatrix}$.	10	K3	CO1
		OR			
	b)	Verify Cayley -Hamilton theorem for $A=\begin{bmatrix} 2 & -1 & 1 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{bmatrix}$ and hence find A^{-1}.	10	K3	CO1
32.	a)	A rectangular box, open at the top, is to have a volume of 32cc. Find the dimensions of box which least amount of material for its construction.	10	K3	CO2
		OR			
	b) i)	Find the extreme values of the function $f(x,y) = x^3 + y^3 - 12x - 3y + 20$.	5	K3	CO2
	ii)	Expand $e^x \cos y$ as a Taylor's series near the point $\left(0, \frac{\pi}{2}\right)$ up to 2nd degree.	5	K3	CO2
33.	a)	Prove that $\vec{F} = (y^2 + 2xz^2)\vec{i} + (2xy - z)\vec{j} + (2x^2z - y + 2z)\vec{k}$ is irrotational and hence find its scalar potential.	10	K3	CO3
		OR			
	b)	Find the angle between the surfaces $x^2 + y^2 + z^2 = 9$ and $z = x^2 + y^2 - 3$ at the point(2,-1,2)	10	K3	CO3
34.	a)	Verify Stoke's theorem for $\vec{F} = (x^2 - y^2)\vec{i} + 2xy\,\vec{j}$ in the rectangular region in the XY plane bounded by the lines $x = 0, x = a, y = 0, y = b$.	10	K3	CO4
		OR			
	b)	Verify Gauss Divergence theorem for $\vec{F} = 4xz\,\vec{i} - y^2\vec{j} + yz\,\vec{k}$ over the cube bounded by $x = 0, x = 1, y = 0, y = 1, z = 0, z = 1$.	10	K3	CO4
35.	a)	Change the order of integration and then integrate $\int_0^a \int_{\frac{x^2}{a}}^{2a-x} xy\,dy\,dx$	10	K3	CO5
		OR			
	b)	Find the volume of sphere $x^2 + y^2 + z^2 = a^2$ using triple integrals.	10	K3	CO5

36. a) Expand $f(x)=\begin{cases} x & (0,\pi) \\ 2\pi - x & (\pi,2\pi) \end{cases}$ as Fourier series and hence deduce that $\frac{1}{1^2}+\frac{1}{3^2}+\frac{1}{5^2}.........=\frac{\pi^2}{8}$ *10 K3 CO6*

OR

b) Find the Fourier series for f(x) = x^2 in $(-\pi . \pi)$ and also prove that $\frac{1}{1^2}+\frac{1}{2^2}+\frac{1}{3^2}+\cdots=\frac{\pi^2}{6}$ *10 K3 CO6*