

[illegible]

Question Paper Code : 30068

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2026.

First Semester

Civil Engineering

MA25C01 — APPLIED CALCULUS

(Common to : All Branches)

(Regulations 2025)

Time : 3 hours

Maximum : 100 marks

(Use of Statistical Table is permitted)

CO – Course Outcomes

CO1	Explain the meaning of derivative, integral, and their geometric and physical interpretations.
CO2	Apply differentiation and integration techniques to compute maxima, minima, and area.
CO3	Analyze the behavior of single and multivariable functions using derivatives and partial derivatives.
CO4	Utilize modern computational software and online platforms to deepen understanding, perform complex calculations, and visualize mathematical concepts.

BL – Bloom's Taxonomy Levels

(L1-Remember, L2-Understand, L3-Apply, L4-Analyze, L5-Evaluate, L6-Create)

Answer ALL questions.

PART – A (Total Marks = 40)

[Q. No. 1 to Q. No. 10 ; $10 \times 1 = 10$ Marks (Multiple Choice Questions)]

Q. No. 11 to Q. No. 20; $10 \times 3 = 30$ Marks]

Q.No.	Questions	Marks	CO	BL
1.	The graph of $y = \sqrt{x}$ is shifted 3 units to the left and 2 units down. Which equation represents the new graph? (A) $y = \sqrt{x-3} - 2$ (B) $y = \sqrt{x-3} + 2$ (C) $y = \sqrt{x+3} - 2$ (D) $y = \sqrt{x+3} + 2$	1	1	1

2.	Evaluate : $\lim_{x \rightarrow 3} \frac{x^2 - 9}{x - 3}$ (A) 0 (B) 3 (C) 6 (D) ∞	1	1	2
3.	The condition for $f(x)$ is minimum at $x = a$ is (A) $f'(a) = 0$ and $f''(a) = 0$ (B) $f'(a) = 0$ and $f''(a) > 0$ (C) $f'(a) = 0$ and $f''(a) < 0$ (D) $f'(a) = 0$ and $f''(a) \rightarrow \infty$	1	1	1
4.	Let $z = x^2 + y^2$, where $x = u + v$ and $y = u - v$. Apply chain rule, find $\frac{\partial z}{\partial u}$ (A) $2u$ (B) $4u$ (C) $4v$ (D) $4(u + v)$	1	2	1
5.	For the function $f(x, y) = x^2 - y^2$, the critical point is (A) (0, 0) (B) (1, -1) (C) (0, 1) (D) (1, 0)	1	2	2
6.	Evaluate : $\int_{-1}^1 x dx$. (A) 0 (B) 1 (C) 2 (D) $\frac{1}{2}$	1	3	2

7.	Evaluate : $\int \sin^2 x \, dx$ (A) $\frac{x}{2} - \frac{\sin 2x}{4} + C$ (B) $\frac{x}{2} + \frac{\sin 2x}{4} + C$ (C) $\frac{x}{2} + \frac{\cos 2x}{4} + C$ (D) $\frac{x}{2} - \frac{\cos 2x}{4} + C$	1	3	1
8.	The area bounded by $y = \sqrt{x}$, the x-axis and $x = 4$ is (A) 8 (B) $8/3$ (C) 16 (D) $16/3$	1	3	2
9.	Find $\int_1^2 \int_3^4 \pi \, dy \, dx$ (A) π (B) 3π (C) 4π (D) 2π	1	4	1
10.	The double integral $\iint_R f(x, y) \, dA$ represents, when $f(x, y) \geq 0$ (A) Area of region R (B) Average value of f over R (C) Volume under the surface $z = f(x, y)$ above R (D) Arc length of the boundary of R	1	4	2
11.	Find the domain of the function $f(x) = \frac{\sqrt{x+2}}{x-3}$	3	1	1
12.	Find $\frac{dy}{dx}$, if $x^{2/3} + y^{2/3} = a^{2/3}$.	3	1	2
13.	What is the effect of the first derivatives on the shape of the function?	3	1	1
14.	Prove $\frac{\partial^2 f}{\partial x \partial y} = \frac{\partial^2 f}{\partial y \partial x}$ if $f = x^3 y^2 + e^{xy}$.	3	2	2

15.	Distinguish between partial derivatives and total derivatives of a function.	3	2	1
16.	Evaluate $\int \frac{dx}{x^2 - 4x + 5}$.	3	3	2
17.	State the Net change theorem in integral calculus.	3	3	1
18.	The velocity of a particle is $v(t) = 2t - 3$ m/s. If the initial position $s(0) = 2$ m, find the position at $t = 4$ seconds.	3	3	2
19.	Sketch the region of the double integral $\int_0^1 \int_y^1 f(x, y) dx dy$.	3	4	1
20.	Find $\int_0^1 \int_0^2 \int_0^3 xyz dx dy dz$.	3	4	2

PART – B (5 × 12 = 60 marks)

Q.No.	Questions	Marks	CO	BL
21.	(a) (i) Find the values of a and b so that $f(x) = \begin{cases} ax+b, & x \leq 1 \\ x^2, & 1 < x \leq 2 \\ bx+a, & x > 2 \end{cases}$ is continuous at $x=1$ and $x=2$.	6	1	3
	(ii) Find the maximum and minimum values of $f(x) = 2x^3 - 9x^2 + 12x - 5$.	6		
	OR			
	(b) (i) If $y = \tan^{-1} x$, show that $(1+x^2)\frac{d^2y}{dx^2} + 2x\frac{dy}{dx} = 0$.	6	1	3
	(ii) State mean value theorem and verify it for the function $f(x) = x^2 + 2x - 3$ in the interval $[0, 2]$.	6		

22.	(a)	(i) If $u = f(x + 2y + 3z, 2x + 3y + z, 3x + y + 2z)$, find the value of $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z}$.	6	2	3
		(ii) Investigate the maximum and minimum values of the function $f(x, y) = 4x^2 - 2xy + y^2 - 8x + 2y + 1$.	6		
	OR				
	(b)	(i) If $u = \sin^{-1}\left(\frac{x^{2/3} + y^{2/3}}{x^{1/3} + y^{1/3}}\right)$, prove that $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = \frac{1}{3} \tan u$.	6	2	3
		(ii) Apply the method of Lagrange's multiplier, find the maximum of $f(x, y) = xy$ on the circle $x^2 + y^2 = 4$.	6		
23.	(a)	Find the greatest and least distances of the point $(3, 4, 12)$ from the unit sphere whose centre is at the origin.	12	2	3
	OR				
	(b)	Evaluate :	12	3	3
24.		(i) $\int \frac{x^4 + 3x^2 - 2x + 5}{\sqrt{x}} dx$			
		(ii) $\int \frac{3x + 5}{(x + 1)(x + 2)} dx$.			
	OR				
	(a)	(i) Evaluate : $I = \int_0^{\pi/2} \log(1 + \tan^2 x) dx$.	6	4	3
		(ii) Find the area of the region bounded by $y = x^2$ and $y = 4x - x^2$.	6		
	OR				

	(b)	(i) Find the arc length of the curve $y = \frac{2}{3}x^{3/2}$ from $x = 0$ to $x = 4$.	6	4	3
		(ii) Find the surface area generated by revolving the curve $y = x^3$ from $x = 0$ to $x = 1$ about the x-axis.	6		
25.	(a)	(i) State Fubini's theorem in first form and verify it for $\iint_R f(x, y) dA$, where $f(x, y) = 100 - 6x^2y$ and $R: 0 \leq x \leq 2, -1 \leq y \leq 1$.	6	5	3
		(ii) Using polar coordinates, evaluate $I = \int_{-a-\sqrt{a^2-x^2}}^a \int_{-\sqrt{a^2-x^2}}^{\sqrt{a^2-x^2}} (x^2 + y^2) dy dx$.	6		
		OR			
	(b)	(i) Change the order of the integration $\int_0^1 \int_{x^2}^x xy dy dx$ and evaluate the same.	6	5	3
		(ii) Using spherical coordinates, find the volume of the sphere $x^2 + y^2 + z^2 = 4$.	6		