

Question Paper Code : 85028

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2025.

First Semester

Civil Engineering

MA25C01 — APPLIED CALCULUS

(Common to : All Branches)

(Regulations 2025)

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Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Evaluate : $\lim_{x \rightarrow -2/3} (9x^2 - 12x - 4)$.
2. Find $\frac{dy}{dx}$, if $ax^2 + 2hxy + by^2 = c$.
3. Prove $\frac{\partial^2 f}{\partial x \partial y} = \frac{\partial^2 f}{\partial y \partial x}$ if $f = x^3 + y^3 + z^3 + 3xyz$.
4. If $z = x^2 + y^2$ and $x = t^2$, $y = 2at$, find $\frac{dz}{dt}$.
5. What is meant by saddle point?
6. Prove that $\int_0^a f(x) dx = \int_0^a f(a-x) dx$.
7. Evaluate : $\int_0^{\frac{\pi}{2}} \cos^7 x dx$.
8. Evaluate : $\int \frac{dx}{x^2 - 6x + 13}$.
9. Find $\int_{-1}^2 \int_x^{x+2} dy dx$.
10. Find $\int_0^1 \int_0^2 \int_0^3 xyz dx dy dz$.

PART B (5 × 16 = 80 marks)

11. (a) (i) For what values of a and b is $f(x) = \begin{cases} ax + 2b & x < 0 \\ x + 3a & b < 0 < x < 2 \\ 3x + 5 & x > 2 \end{cases}$ continuous at every x (8)
- (ii) State mean value theorem and verify it for the function $f(x) = x^2 - 4x + 3$ in the interval $[1, 4]$ (8)

Or

- (b) (i) If $y = \sin^{-1} x$, show that $(1 - x^2) \frac{d^2y}{dx^2} - x \frac{dy}{dx} = 0$. (8)
- (ii) Find the maximum and minimum values of $f(x) = 3x^3 + 4x^2 - 12x + 12$ (8)

12. (a) (i) If $u = f(x - y, y - z, z - x)$, prove $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = 0$ (6)
- (ii) Expand $e^x \sin y$ as a Taylor's series at $(0, 0)$ upto third degree terms. (10)

Or

- (b) (i) If $u = \sin^{-1} \left(\frac{x+y}{\sqrt{x} + \sqrt{y}} \right)$, prove that $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = \frac{1}{2} \tan u$. (6)

- (ii) Find the greatest and least distances of the point $(3, 4, 12)$ from the unit sphere whose centre is at the origin. (10)

- (i) Examine the function $f(x, y) = x^4 + y^4 - 2x^2 - 2y^2 + 4xy$ for extreme values (8)

- (ii) Evaluate $\int \frac{dx}{\sqrt{5x^2 - 2x}}$ (8)

Or

- (b) (i) Find the minimum value of $x^2 + y^2 + z^2$ given that $ax + by + cz = p$. (8)

- (ii) Evaluate : $I = \int_0^{\frac{\pi}{2}} \log \sin x \, dx$. (8)

(i) Use partial fraction method, evaluate $\int \frac{3x - 2}{(x+1)^2(x+3)} dx$. (8)

(ii) Find the area enclosed by the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$. (8)

Or

(i) Evaluate: $\int_0^{\frac{\pi}{2}} \frac{\sqrt{\sin x}}{\sqrt{\sin x} + \sqrt{\cos x}} dx$. (8)

(ii) Find the surface area of the solid obtained by rotating the line segment $y = 2x + 1$, from $x = 0$ to $x = 3$, about the x -axis. (8)

(i) Change the order of the integration $\int_0^1 \int_{x^2}^{2-x} xy \, dy \, dx$ and evaluate the same. (8)

(ii) Using polar coordinates, evaluate $I = \int_0^a \int_0^{\sqrt{a^2-x^2}} (x^2 + y^2) \, dy \, dx$. (8)

Or

(b) (i) Calculate the volume of the solid bounded by the planes $x = 0$, $y = 0$, $z = 0$, $x + y + z = 1$, by triple integrals. (8)

(ii) Using spherical coordinates, find the volume of the sphere $x^2 + y^2 + z^2 = a^2$. (8)