Reg. No. : | | | | | | | | | | | | |

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)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Evaluate : $\lim_{x \to -2/3} \left(9x^2 - 12x - 4\right)$.

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 $\int_0^1 \int_0^2 \int_0^3 xyz \; dxdydz$.

PART B — (5 × 16 = 80 marks)

11. (a) (i) For what values of a and b is $f(x)=\begin{cases} ax+2b, & x \le 0 \\ x^2+3a-b, & 0<x\le 2 \\ 3x-5, & x>2 \end{cases}$ 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 $f(x)=3x^4+4x^3-12x^2+12$. (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)

13. (a) (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)

14. (a) (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

(b) (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)

15. (a) (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)

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