



PARUL UNIVERSITY

Faculty of Engineering & Technology

Department of Applied Sciences and Humanities

1ST SEMESTER B.Tech PROGRAMME (CSE, IT)

CALCULUS(03019101BS01)

ACADEMIC YEAR – 2025-26

Assignment 2: Multivariate Calculus

Q.A Answer the following: (Short Question's)

1. If $f(x, y) = c$ then $\frac{dy}{dx}$ is
 (a) $\frac{f_x}{f_y}$ (b) $-\frac{f_x}{f_y}$ (c) $\frac{f_y}{f_x}$ (d) $-\frac{f_y}{f_x}$
2. If $f(x, y) = x^y$ then find $\frac{\partial f}{\partial x}$ is
 (a) $y x^{y-1}$ (b) $x x^{y-1}$ (c) $y y^{x-1}$ (d) $x x^{x-1}$
3. The degree of homogeneous function $f(x, y) = \log\left(\frac{x}{y}\right)$
 (a) 0 (b) 1 (c) 2 (d) -1
4. If $u = x + y, v = x - y$, then $\frac{\partial(u,v)}{\partial(x,y)}$ is
 (a) 0 (b) 1 (c) -2 (d) 2
5. The degree of homogeneous function $f(x, y) = \frac{x^2+y^2}{xy}$
 (a) 0 (b) 1 (c) 2 (d) 3
6. What is the equation of the tangent at a specific point of $y^2 = 4ax$ at $(0,0)$?
7. What is degree of homogeneous function $\left(\frac{x}{y}\right) + g\left(\frac{y}{x}\right)$?
8. If $x = r \cos \theta, y = r \sin \theta$ then find $\frac{\partial r}{\partial x}$
9. If $J = \frac{\partial(x,y)}{\partial(u,v)}$, and $J' = \frac{\partial(u,v)}{\partial(x,y)}$ then $JJ' =$ _____
10. Evaluate $\lim_{(x,y) \rightarrow (1,1)} \frac{x-y}{\sqrt{x}-\sqrt{y}}$

11. Define: Homogeneous function
12. Write statement of modified Euler's theorem.
13. Find $f_x(1,3)$ for the function $f(x,y) = x^2y + xy^2$.
14. Find $\frac{\partial f}{\partial x}(1,2)$ for the function $f(x,y) = x^3 + y^3 - 3xy$.
15. If $y \sin x = x \cos y$, find $\frac{dy}{dx}$.

Q.B [A] Answer the following:

1. Find $\frac{\partial u}{\partial x}$ and $\frac{\partial u}{\partial y}$ at $(-2, -2)$ for $u = x^2 - y^2$.
2. Discuss the continuity of

$$f(x,y) = \begin{cases} \frac{x^2-y^2}{x^2+y^2}, & (x,y) \neq (0,0) \\ 0 & (x,y) = (0,0) \end{cases} \text{ at point } (0,0).$$

3. Show that the function $f(x,y) = \frac{2x^2y}{x^4+y^2}$ has no limit as (x,y) approaches to $(0,0)$
4. If $u = x^2y + y^2z + z^2x$, then find $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z}$
5. Check whether following function is continuous or not?

$$f(x,y) = \begin{cases} \frac{x^2y^2}{4x^2+5y^2}, & (x,y) \neq (0,0) \\ 0 & (x,y) = (0,0) \end{cases} \text{ at point } (0,0).$$
6. Find the value of $\frac{\partial f}{\partial x}, \frac{\partial f}{\partial y}$ at point $(1,2)$ if $f(x,y) = x^2 + 2xy + 3y^2 - 1$
7. Find the value of $\frac{\partial u}{\partial x}, \frac{\partial u}{\partial y}$ at point $(-2, -2)$ if $f(x,y) = x^2 - y^2$
8. Find the equations of tangent plane and normal line to the surface $\frac{x^2}{4} + y^2 + \frac{z^2}{9} = 3$ at $(-2,1, -3)$

Q.B [B] Answer the following:

1. If $u = y^2 e^{\frac{y}{x}} + x^2 \log\left(\frac{x}{y}\right)$, prove that
 - (i) $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = 2u$
 - (ii) $x^2 \frac{\partial^2 u}{\partial x^2} + 2xy \frac{\partial^2 u}{\partial x \partial y} + y^2 \frac{\partial^2 u}{\partial y^2} = 2u$
2. Discuss the maxima and minima of the function $f(x,y) = x^3 + 3xy^2 - 15x^2 - 15y^2 + 72x$

3. If $u = \sin^{-1} \left(\frac{x^{\frac{1}{4}} - y^{\frac{1}{4}}}{x^{\frac{1}{5}} - y^{\frac{1}{5}}} \right)$, then find

(i) $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y}$

(ii) $x^2 \frac{\partial^2 u}{\partial x^2} + 2xy \frac{\partial^2 u}{\partial x \partial y} + y^2 \frac{\partial^2 u}{\partial y^2}$