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Calculus for MBBS Students

1. $y - 3x - 2 = 0$ and $3y + x + 9 = 0$

$$y = 3x + 2 \quad \text{--- (1)}$$

$$3y = -x - 9$$

$$y = -\frac{1}{3}x - 3 \quad \text{--- (2)}$$

$$\therefore m_1 = 3 \quad ; \quad m_2 = -\frac{1}{3} \quad \quad m_1 m_2 = -1$$

$$3 \times -\frac{1}{3} = -1$$

Hence $y - 3x - 2 = 0$ and $3y + x + 9 = 0$ are perpendicular to each other.

2. $3y - 4 = 2x + 3$ and $y - 5 = x + 6$

$$3y = 2x + 3 + 4$$

$$y = x + 6 - 5$$

$$y = \frac{2}{3}x + \frac{7}{3}$$

$$\text{and } y = x + 1$$

$$m_1 = \frac{2}{3} \quad m_2 = 1$$

$$\frac{2}{3} + 1 = \frac{5}{3}$$

Hence $3y - 4 = 2x + 3$ and $y - 5 = x + 6$ are not perpendicular to each other.

3. $x^2 + y^2 + 3xy - 11 = 0$ (1, 2)

$$m \frac{dy}{dx} \Big|_{x=1} = 2x + 2y \frac{dy}{dx} + 3 \left[x \cdot \frac{dy}{dx} + y \cdot 1 \right] = 0$$

$$= 2x + 2y \frac{dy}{dx} + 3x \frac{dy}{dx} + 3y = 0$$

$$2y \frac{dy}{dx} + \frac{dy}{dx} (2y + 3x) = \frac{-2x - 3y}{2y + 3x}$$

$$\therefore \frac{dy}{dx} = \frac{(2x + 3y)}{2x + 3y} = 1 \quad \quad \frac{-(2x - 3y)}{2x + 3y}$$

$$\therefore m = \frac{-2(1) - 3(2)}{2(2) + 3(1)} = \frac{-2 - 6}{4 + 3} = \frac{-8}{7} = -\frac{8}{7}$$

For equation of tangent

$$y - y_1 = m(x - x_1)$$

$$y - 2 = \frac{-8}{7}(x - 1)$$

$$7(y - 2) = -8x + 8$$

$$7y - 14 = -8x + 8$$

$$7y = -8x + 22$$

$$y = \frac{-8}{7}x + \frac{22}{7}$$

For equation of normal :

$$m_2 = \frac{-1}{m_1} = -1 \times \frac{7}{-8} = \frac{7}{8}$$

$$\therefore y - y_1 = m(x - x_1)$$

$$y - 2 = \frac{7}{8}(x - 1)$$

$$8(y - 2) = 7(x - 1)$$

$$8y - 16 = 7x - 7$$

$$8y = 7x - 7 + 16$$

$$\frac{8y}{8} = \frac{7x + 9}{8}$$

$$\therefore y = \frac{7}{8}x + \frac{9}{8}$$