# CONCEPT MAP

FORM 5

## DIFFERENTIATION

### Meaning of Differentiation

**Limits**

**Differentiation Using First Principles**

$$\frac{dy}{dx} = \lim_{\delta x \to 0} \frac{\delta y}{\delta x}$$

### Techniques of Differentiation

$$y = ax^n \Rightarrow \frac{dy}{dx} = nax^{n-1}$$

$$y = uv \Rightarrow \frac{dy}{dx} = u\frac{dv}{dx} + v\frac{du}{dx}$$

$$y = \frac{u}{v} \Rightarrow \frac{dy}{dx} = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2}$$

$$y = k[f(x)]^n \Rightarrow \frac{dy}{dx} = kn[f(x)]^{n-1}f'(x)$$

Chain Rule: $\frac{dy}{dx} = \frac{dy}{du} \times \frac{du}{dx}$

### Applications of Differentiation

**Gradient of a Curve**

$m = f'(x_1)$

**Equations of Tangents and Normals**

$y - y_1 = m(x - x_1)$, $m = f'(x_1)$ for tangent and

$m = -\frac{1}{f'(x_1)}$ for normals

**Rate of Change**

$$\frac{dy}{dt} = \frac{dy}{dx} \times \frac{dy}{dt}$$

**Small Change**

$$\delta y \approx \frac{dy}{dx} \times \delta x$$

**Approximation**

$$y_{new} = y_{original} + \frac{dy}{dx}(\delta x)$$

**Second Derivatives**

$$\frac{d^2y}{dx^2} = f''(x_1)$$

Turning Points: $\frac{dy}{dx} = 0$

$\frac{d^2y}{dx^2} > 0$ for minimum point

$\frac{d^2y}{dx^2} < 0$ for maximum point

**Problems Involving Maximum and Minimum Problems**