□ Class 12 Mathematics – Chapter: Applications of Derivatives

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1. Introduction

- Derivatives help analyze the behavior of functions.
- Used to find rates of change, slopes, and optimize real-world problems.

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2. Rate of Change of Quantities

- Derivative represents the instantaneous rate of change.
- Example: Velocity is the rate of change of displacement.

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3. Increasing and Decreasing Functions

- A function f(x)f(x)f(x) is **increasing** in an interval if f′(x)>0f'(x) > 0f′(x)>0.
- It is **decreasing** if f′(x)<0f'(x) < 0f′(x)<0.
- Use derivative test to determine intervals of increase or decrease.

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4. Tangents and Normals

- **Tangent line:** Line touching the curve at one point with slope f'(x)f'(x)f'(x).
- Equation of tangent at x=ax = ax=a:

  y−f(a)=f'(a)(x−a)y - f(a) = f'(a)(x - a)y−f(a)=f'(a)(x−a)
- **Normal line:** Perpendicular to tangent.
  Slope of normal = −1f'(a)-\frac{1}{f'(a)}−f'(a)1.

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5. Maxima and Minima

- Points where function attains local maximum or minimum.
- Use **First Derivative Test:**
  - f'(x)=0f'(x) = 0f'(x)=0 and changes sign from + to − ⇒ local max.
  - f'(x)=0f'(x) = 0f'(x)=0 and changes sign from − to + ⇒ local min.
- Use **Second Derivative Test:**
  - f''(a)>0f''(a) > 0f''(a)>0 ⇒ local min.

- f''(a)<0f''(a) < 0f''(a)<0 ⇒ local max.

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6. Applications in Real Life

- Finding maximum profit, minimum cost.
- Optimizing area, volume in geometry.
- Physics: motion problems.

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7. Exam Tips

- Practice derivative tests for maxima and minima.
- Know formulas for tangent and normal.
- Solve word problems involving optimization.
- Understand physical interpretation of derivatives.