

Salahaddin University-Erbil
College of Engineering
Department of Water Resources Engineering
2023/2024



Mathematics II

Transcendental Function

Chapter Six

Shawnm Mudhafar Saleh

shawnm.saleh@su.edu.krd

6.3. Derivative of Inverse Trigonometric Function

- Derivatives:

$$\frac{d}{dx} (\sin^{-1} u) = \frac{1}{\sqrt{1-u^2}} \frac{du}{dx}$$

$$\frac{d}{dx} (\cos^{-1} u) = -\frac{1}{\sqrt{1-u^2}} \frac{du}{dx}$$

$$\frac{d}{dx} (\tan^{-1} u) = \frac{1}{1+u^2} \frac{du}{dx}$$

$$\frac{d}{dx} (\cot^{-1} u) = -\frac{1}{1+u^2} \frac{du}{dx}$$

$$\frac{d}{dx} (\sec^{-1} u) = \frac{1}{|u|\sqrt{u^2-1}} \frac{du}{dx}$$

$$\frac{d}{dx} (\csc^{-1} u) = -\frac{1}{|u|\sqrt{u^2-1}} \frac{du}{dx}$$

6.3. Derivative of Inverse Trigonometric Function

Differentials:

$$d(\sin^{-1} u) = \frac{du}{\sqrt{1-u^2}}$$

$$d(\cos^{-1} u) = -\frac{du}{\sqrt{1-u^2}}$$

$$d(\tan^{-1} u) = \frac{du}{1+u^2}$$

$$d(\cot^{-1} u) = -\frac{du}{1+u^2}$$

$$d(\sec^{-1} u) = \frac{du}{|u|\sqrt{u^2-1}}$$

$$d(\csc^{-1} u) = -\frac{du}{|u|\sqrt{u^2-1}}$$

6.3. Derivative of Inverse Trigonometric Function

Examples:

$$y = \sin^{-1} x$$

$$y = \sec^{-1} x$$

Integral Formula:

$$\int \frac{du}{\sqrt{1-u^2}} = \sin^{-1} u + c$$

$$\int -\frac{du}{\sqrt{1-u^2}} = \cos^{-1} u + c$$

$$\int \frac{du}{1+u^2} = \tan^{-1} u + c$$

$$\int -\frac{du}{1+u^2} = \cot^{-1} u + c$$

$$\int \frac{du}{u\sqrt{u^2-1}} = \sec^{-1} u + c$$

$$\int -\frac{du}{u\sqrt{u^2-1}} = \csc^{-1} u + c$$

Example:

Find dy/dx for the followings:

1. $y = \sin^{-1} x^2$

2. $y = \tan^{-1} \sqrt{x+1}$

3. $y = \sec^{-1} 3x$

Evaluate

$$\int_0^1 \frac{dx}{1+x^2}$$

$$\int \frac{x^2 dx}{\sqrt{1-x^6}}$$

$$\int \frac{dx}{\sqrt{9-x^2}}$$