Department of biology

((GENERAL MATHEMATICS))

**1st stage**

**Week 7- lecture 7**

# Trigonometric Functions

# الدوال المثلثية

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# Trigonometric Functions and Their Derivatives

## What Are Trigonometric Functions?

Trigonometric functions describe the relationships between the angles and sides of a right triangle. The basic functions are:

1. Sine ($\sin(x)$)
2. Cosine ($\cos(x)$)
3. Tangent ($\tan(x)$)
4. Cosecant ($\csc(x)$)
5. Secant ($\sec(x)$)
6. Cotangent ($\cot(x)$)

## Derivatives of Trigonometric Functions

The derivatives of trigonometric functions are fundamental and commonly used in calculus.

| Function | Derivative |
|---|---|
| $\sin(x)$ | $\cos(x)$ |
| $\cos(x)$ | $-\sin(x)$ |
| $\tan(x)$ | $\sec^2(x)$ |
| $\csc(x)$ | $-\csc(x)\cot(x)$ |
| $\sec(x)$ | $\sec(x)\tan(x)$ |
| $\cot(x)$ | $-\csc^2(x)$ |

Examples:-

**1. Find the derivative of $f(x) = \sin(x)$:**

$$f'(x) = \cos(x)$$

**2. Find the derivative of $f(x) = \cos(x) + \sin(x)$:**

$$f'(x) = -\sin(x) + \cos(x)$$

**3. Find the derivative of $f(x) = 2\tan(x)$:**

$$f'(x) = 2\sec^2(x)$$

**4. Find the derivative of $f(x) = \sin(2x)$:**

$$f'(x) = 2\cos(2x)$$

**5. Find the derivative of $f(x) = \cos(3x)$:**

$$f'(x) = -3\sin(3x)$$

**6. Find the derivative of $f(x) = \tan(\pi x)$:**

$$f'(x) = \pi\sec^2(\pi x)$$

**7. Find the derivative of $f(x) = x\sin(x)$:**

$$f'(x) = x\cos(x) + \sin(x)$$

**8. Find the derivative of $f(x) = x^2 \cos(x)$:**

$$f'(x) = 2x \cos(x) - x^2 \sin(x)$$

**9. Find the derivative of $f(x) = \sin^2(x)$:**

$$f'(x) = 2 \sin(x) \cos(x)$$

**10. Find the derivative of $f(x) = \cos^3(x)$:**

$$f'(x) = -3 \cos^2(x) \sin(x)$$

**11. Find the derivative of $f(x) = \sin(\cos(x))$:**

$$f'(x) = \cos(\cos(x)) \cdot (-\sin(x))$$

**12. Find the derivative of $f(x) = \tan(\sin(x))$:**

$$f'(x) = \sec^2(\sin(x)) \cdot \cos(x)$$

## Key Identities for Simplification

1. $\sin^2(x) + \cos^2(x) = 1$
2. $1 + \tan^2(x) = \sec^2(x)$
3. $1 + \cot^2(x) = \csc^2(x)$