

Salahaddin University-Erbil
College of Engineering
Department of Architectural Engineering
First Year Students
2nd Semester



Mathematics I

Integration

Definite Integration and Area Under the Curve (Ch.4)

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Integration

Definite integration

The symbol for the number I in the definition of the definite integrals is

$$\int_a^b f(x)dx$$

Rules satisfied by definite integrals

1. *Order of Integration:* $\int_b^a f(x) dx = -\int_a^b f(x) dx$ A Definition
2. *Zero Width Interval:* $\int_a^a f(x) dx = 0$ A Definition
when $f(a)$ exists
3. *Constant Multiple:* $\int_a^b kf(x) dx = k\int_a^b f(x) dx$ Any constant k
4. *Sum and Difference:* $\int_a^b (f(x) \pm g(x)) dx = \int_a^b f(x) dx \pm \int_a^b g(x) dx$
5. *Additivity:* $\int_a^b f(x) dx + \int_b^c f(x) dx = \int_a^c f(x) dx$

Evaluate:

- $\int_{1/2}^{3/2} (-2x + 4) dx$

- $\int_1^0 (3x^2 + x - 5) dx$

Area under the curve

- **Definition**

If $y = f(x)$ is nonnegative and integrable over a closed interval $[a,b]$, then the area under the curve $y = f(x)$ over $[a,b]$ is the integrals of f from a to b ,

$$A = \int_a^b f(x) dx$$

Examples

Find the area between the x-axis and the given curve

1. $y = 4 - x^2$ for $-2 \leq x \leq 2$

2. $y = x^3 - 4x$ for $-2 \leq x \leq 2$

Steps for finding area when f has both positive and negative values on $[a,b]$

1. Find points where $f=0$
2. Use the zeros of f to partition steps for finding area when f has both positive and negative values on $[a,b]$ into sub intervals.
3. Integrate f over each sub interval.
4. Add the absolute values of the results.

Next lecture we will learn

- Application of integration