

Section 5.3 *The fundamental theorem of calculus*

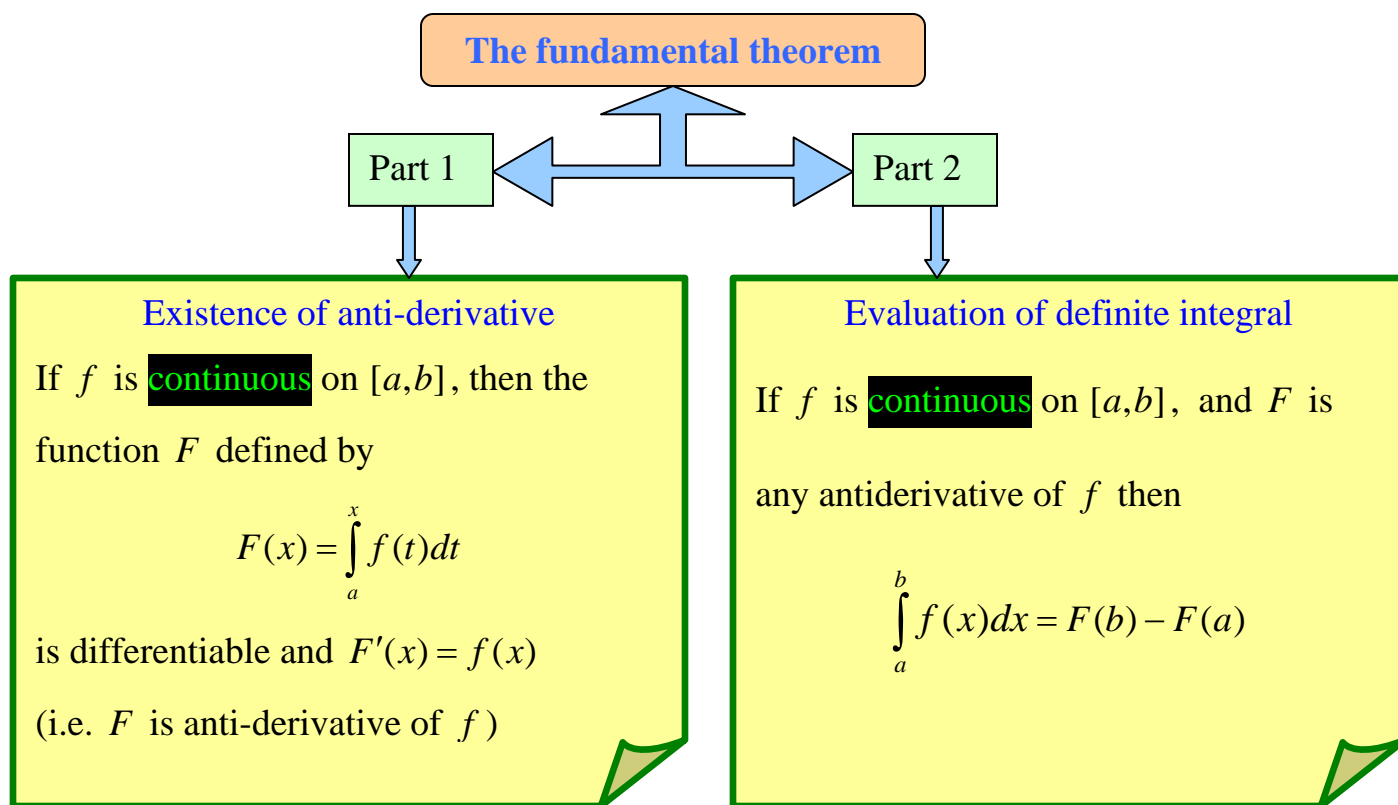
Learning outcomes

After completing this section, you will inshaAllah be able to

1. know what is **fundamental theorem of calculus**
2. evaluate **definite integrals using Part 2** of fundamental theorem of calculus
3. apply **Part 1 of fundamental theorem** (to solve problems)
4. understand (and work with) **functions defined as integral**

Fundamental theorem of calculus

- Until now we have calculated definite integrals by ways which are restricted and not practical.
- Here we look for an efficient method of calculating definite integrals
- The fundamental theorem is very useful because it
 - relates $\int_a^b f(x)dx$ with integration (or differentiation)
 - gives efficient way of calculating definite integrals



Evaluating definite integrals using fundamental theorem (Part 2)**Best Strategy**

A combination of **properties** (done in Sec. 5.2) and **fundamental theorem**

See examples 1, 2, 3 done in class

Do exercises given in class

Applying Part 1 of Fundamental Theorem**Main Point**

To bring in proper form
before using formula

$$\frac{d}{dx} \left(\int_a^x f(t) dt \right) = f(x)$$

See examples 4, 5, 6, 7, 8 done in class

Do exercises given in class

Functions defined as integral
How to work with such functions?

Main tool

Fundamental theorem Part 1

- Is $f(x) = \frac{2}{\sqrt{\pi}} \int_0^x e^{-t^2} dt$ a function.

- Yes. See class explanation.
- Called functions defined by integrals

- Why do we need to study such functions?

- See class explanation.

- How to differentiate such functions?

- Use “Fundamental Theorem Part 1”

Standard Notation

$$\operatorname{erf}(x) = \frac{2}{\sqrt{\pi}} \int_0^x e^{-t^2} dt$$

See examples 9, 10 done in class

Do exercise given in class

End of Section 5.3