Portland State UNIVERSITY

Fariborz Maseeh Department of Mathematics and Statistics

MTH 252: Calculus II

Updated Fall 2021

Course Description: Integral calculus of functions of a single variable, including the Fundamental Theorem of Calculus, numerical integration and applications. This is the second course in a sequence of three: Mth 251, Mth 252, and Mth 253, which must be taken in sequence.

Credits: 4

Prerequisite: Mth 251

Course Objectives: This is the second course in a sequence of three: Mth 251, Mth 252 and Mth 253 which must be taken in sequence. The course focuses on the basic integral calculus of real-valued functions of a single variable. This includes integration techniques, numerical integration, and applications of integrals.

Student Learning Outcomes: Upon completion of this course students will be able to:

- Interpret and evaluate Riemann sums for real-valued functions.
- Relate Riemann sums to definite integrals and interpret these integrals as areas of planar regions.
- Apply properties of the definite integral to manipulate and simplify expressions.
- Understand net change as the integral of a rate.
- Approximate definite integrals numerically using Riemann sums, trapezoids, and Simpson's Rule.
- Evaluate improper integrals using limits and comparisons.
- Correctly employ strategies and techniques of integration, including substitution, integration by parts, partial fractions, and trigonometric substitutions.
- Model and solve several types of applications using integration for area, volume, density, work, and arc length.
- Approximate functions using Taylor polynomials.

Topics:

1. *Integration:* Calculation of area; definite integrals; Riemann sums; indefinite integrals; Fundamental Theorem of Calculus; integrals of rates of change.
2. *Applications of Integration:* Area between curves, exponential growth and decay, volume by slices, density, average value, solids of revolution, cylindrical shells, work and energy.
3. *Techniques of Integration:* Substitution, transcendental functions, integration by parts, trigonometric integrals, trigonometric substitution, partial fractions, improper integrals.
4. *Numerical Integration and Further Applications:* Numerical integration, Riemann sums, trapezoid rule, Simpson's Rule, arc length, Taylor polynomials, probability and integration, fluid pressure and force, center of mass.

Textbook:

Jon Rogawski, Colin Adams, and Robert Franzosa *Calculus: Early Transcendentals*, 4th ed., Freeman, W.H.& Company 2019.

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MTH 252 Textbook Mapping:
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The course uses an online homework system from Edfinity Courseware

5 The Integral
- 5.1 Approximating and Computing Area
- 5.2 The Definite Integral
- 5.3 The Indefinite Integral
- 5.4 The Fundamental Theorem of Calculus, Part I
- 5.5 The Fundamental Theorem of Calculus, Part II
- 5.6 Net Change as the Integral of a Rate of Change
- 5.7 The Substitution Method
- 5.8 Further Integral Formulas

6 Applications of the Integral *(Instructor can cover Ch 6 after Ch 7)*
- 6.1 Area Between Two Curves
- 6.2 Setting Up Integrals: Volume, Density, Average Value
- 6.3 Volumes of Revolution: Disks and Washers
- 6.4 Volumes of Revolution: Cylindrical Shells
- 6.5 Work and Energy (OPTIONAL)

7 Techniques of Integration
- 7.1 Integration by Parts
- 7.2 Trigonometric Integrals (OPTIONAL)
- 7.3 Trigonometric Substitution
- 7.4 Integrals of Hyperbolic and Inverse Hyperbolic Functions (OPTIONAL)
- 7.5 The Method of Partial Fractions
- 7.6 Strategies for Integration
- 7.7 Improper Integrals
- 7.8 Numerical Integration

8 Further Applications of the Integral
- 8.1 Probability and Integration
- 8.2 Arc Length and Surface Area
- 8.3 Fluid Pressure and Force (OPTIONAL)
- 8.4 Center of Mass (OPTIONAL)

10 Infinite Series
- 10.7 Taylor Polynomials