MATH 1B: CALCULUS

Foothill College Course Outline of Record

Heading	Value
Effective Term:	Summer 2025
Units:	5
Hours:	5 lecture per week (60 total per quarter)
Prerequisite:	MATH 1A or 1AH.
Advisory:	Demonstrated proficiency in English by placement via multiple measures OR through an equivalent placement process OR completion of ESLL 125 & ESLL 249; not open to students with credit in MATH 1BH.
Degree & Credit Status:	Degree-Applicable Credit Course
Foothill GE:	Area 2: Mathematical Concepts & Quantitative Reasoning
Transferable:	CSU/UC
Grade Type:	Letter Grade (Request for Pass/No Pass)
Repeatability:	Not Repeatable

Student Learning Outcomes

- Students will solve problems involving applications of integration of functions of a single variable.
- Students will develop conceptual understanding of integration of functions of a single variable. They will learn to demonstrate and communicate this understanding in a variety of ways, such as: reasoning with definitions and theorems, connecting concepts, and connecting multiple representations, as appropriate.
- Students will demonstrate the ability to compute and approximate integrals of functions of a single variable.

Description

Introduction to integral calculus, including definite and indefinite integrals, the first and second fundamental theorems and their applications to geometry, physics, and the solution of elementary differential equations.

Course Objectives

The student will be able to:

1. Define the antiderivative and determine antiderivatives of simple functions.
2. Demonstrate an understanding of and evaluate and approximate definite integrals.
3. Find antiderivatives graphically and analytically.
4. Use the first and second fundamental theorems of calculus to evaluate definite integrals and construct antiderivatives.
5. Evaluate a definite integral as a limit.
6. Apply integration to find area.
7. Evaluate definite and indefinite integrals using a variety of integration formulas and techniques.
8. Apply integration to areas and volumes, and other applications such as work or length of a curve.
9. Evaluate improper integrals.
10. Graph and differentiate functions in polar and parametric form.
11. Graph and integrate functions in polar and parametric forms.
12. Solve and interpret solutions to elementary differential equations.
13. Use technology, such as graphing calculators and/or computer software to assist in solving problems involving any of the topics in (1) through (12) above.
14. Discuss mathematical problems and write solutions in accurate mathematical language and notation.
15. Interpret mathematical solutions.

Course Content

1. Define the antiderivative and determine antiderivatives of simple functions
   a. Find general antiderivatives
   b. Antiderivatives in the context of rectilinear motion
   c. Graphing antiderivatives
   d. Families of curves
2. Demonstrate an understanding of and evaluate and approximate definite integrals
   a. Signed area under a curve and the net change of a function F from f
   b. Properties of integrals
   c. Approximating definite integrals
   d. Interpretations of the definite integral
   e. Average value of a function
   f. Numerical approximations to definite integrals using rectangular, trapezoidal and Simpson's approximation and estimation of errors
3. Find antiderivatives graphically, and analytically
   a. The graphical relationship between a function and its antiderivatives
   b. Construction of antiderivatives analytically
4. Use the first and second fundamental theorems of calculus to evaluate definite integrals and construct antiderivatives
   a. Fundamental theorem of calculus I for evaluating definite integrals
   b. Fundamental theorem of calculus II for constructing antiderivatives
   c. Fundamental theorem of calculus for evaluating improper integrals
5. Evaluate a definite integral as a limit
   a. Riemann sum
6. Apply integration to find area
   a. Signed area under a curve
7. Evaluate definite and indefinite integrals using a variety of integration formulas and techniques
   a. Integration by substitution
   b. Integration by parts
   c. Integration by partial fraction expansion
   d. Integration using trigonometric substitutions
   e. Integrals of inverse functions
   f. Integrals of trigonometric, exponential and logarithmic functions

8. Apply integration to areas and volumes, and other applications, such as work or length of a curve
   a. Applications of integration to general problems from geometry involving areas, volumes and arc length
   b. Surfaces of revolution
   c. Volume of a solid of revolution
   d. Applications of definite integrals to problems from physics such as work, moments and centers of mass
   e. Applications of integrals to solve simple differential equations of motion
9. Evaluate improper integrals
   a. Find improper integrals
   b. Interpret improper integrals
10. Graph and differentiate functions in polar and parametric form
    a. Tangents to parametric and polar curves
11. Graph and integrate functions in polar and parametric forms
    a. Parametric curves
    b. Polar curves
12. Solve and interpret solutions to elementary differential equations
    a. Verification of solutions to elementary differential equations
    b. Use of slope fields to get qualitative information about solutions to differential equations
    c. Solutions to elementary first order differential equations by separation of variables
    d. Applications of differential equations to growth and decay problems
13. Use technology such as graphing calculators and/or computer software to assist in solving problems involving any of the topics in (1) through (12) above
    a. Calculator/computer utilities for evaluating definite integrals
    b. Calculator/computer utilities for constructing graphs of antiderivatives
    c. Calculator/computer programs for approximating definite integrals
14. Discuss mathematical problems and write solutions in accurate mathematical language and notation
    a. Application problems from other disciplines
    b. Proper notation
15. Interpret mathematical solutions
    a. Explain the significance of solutions to application problems

Lab Content

Not applicable.

Special Facilities and/or Equipment

1. Access to graphing technology, such as a graphing calculator or graphing software
2. When taught online or hybrid:
a. Internet access
b. Course management system
c. Specific software related to the course

Method(s) of Evaluation

Methods of Evaluation may include but are not limited to the following:

Written homework

Quizzes and tests
Proctored comprehensive final examination

Method(s) of Instruction

Methods of Instruction may include but are not limited to the following:

Lecture
Discussion
Cooperative learning exercises

Representative Text(s) and Other Materials

Boelkins, Matthew. Active Calculus. 2023.

Strang, Gilbert, and Edwin Herman. Calculus Volume II (OpenStax). 2023.

Briggs, William, and Lyle Cochran. Calculus Early Transcendentals, 3rd ed.. 2018.

Types and/or Examples of Required Reading, Writing, and Outside of Class Assignments

1. Homework problems covering subject matter from text and related material ranging from 30-60 problems per week. Students will need to employ critical thinking in order to complete assignments.
2. Five hours per week of lecture covering subject matter from text and related material. Reading and study of the textbook, related materials, and notes.
3. Student projects covering subject matter from textbook and related materials. Projects will require students to discuss mathematical problems, write solutions in accurate mathematical language and notation, and interpret mathematical solutions. Projects may require the use of a computer algebra system, such as Mathematica or MATLAB.
4. Worksheets: Problems and activities covering the subject matter. Such problems and activities will require students to think critically. Such worksheets may be completed inside and/or outside of class.

Discipline(s)

Mathematics