MATH 1A: 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 47 or MATH 48C or equivalent.
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 1AH.
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 limits and rates of change of functions of a single variable.
- Students will develop conceptual understanding of limits and rates of change of functions of a single variable. They will 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 limits and rates of change for functions of a single variable.

Description

Introduction to differential calculus, including limits, derivatives and their applications to curve-sketching, families of functions, and optimization.

Course Objectives

The student will be able to:

1. Demonstrate an understanding of and compute limits of functions at real numbers.
2. Determine if a function is continuous at a real number.
3. Find the derivative of a function as a limit.
4. Find the equation of a tangent line to a function.
5. Compute derivatives using differentiation formulas.
6. Use implicit differentiation.
7. Graph and differentiate functions in polar and parametric form.
8. Demonstrate an understanding of and calculate first, second and higher-order derivatives.
9. Graph functions using methods of calculus.
10. Use differentiation to solve applications, such as related rate problems and optimization problems.
11. Define the antiderivative and determine antiderivatives of simple functions.
12. Use technology, such as graphing calculators and/or computer software to assist in solving problems involving any of the topics in (1) through (11) above.
13. Discuss mathematical problems and write solutions in accurate mathematical language and notation.
14. Interpret mathematical solutions.

Course Content

1. Demonstrate an understanding of and compute limits of functions at real numbers
   a. One sided and two sided limits
   b. Finding limits graphically
   c. The limit laws
   d. Compute limits using numerical and algebraic approaches
   e. Indeterminate forms and l'Hospital's Rule
   f. Formal definition of a limit
2. Determine if a function is continuous at a real number
   a. Continuity
   b. Intermediate Value Theorem
   c. Continuity and differentiability
3. Find the derivative of a function as a limit
   a. Use the definition to find derivatives of functions at a point
   b. Use the definition to find derivatives of functions
4. Find the equation of a tangent line to a function
   a. Average and instantaneous rates of change
   b. Slopes of secant and tangent lines
5. Compute derivatives using differentiation formulas
   a. Power rule
   b. Product rule
   c. Quotient rule
   d. Chain rule
   e. Differentiation of exponential functions
   f. Differentiation of logarithmic functions
   g. Differentiation of inverse functions
   h. Differentiation of trigonometric functions
6. Use implicit differentiation
   a. Equations to tangent lines at points of implicit curves
   b. Use implicit differentiation to find the derivative of an equation of two variables
7. Graph and differentiate functions in polar and parametric form
   a. Tangents to parametric and polar curves
8. Demonstrate an understanding of and calculate first, second and higher-order derivatives
   a. Calculate first derivatives
   b. Calculate second derivatives
   c. Calculate higher order derivatives
9. Graph functions using methods of calculus
   a. Critical points
   b. Graphing functions using the first and second derivatives
   c. Relative extrema
   d. Global extrema

   e. Inflection points
   f. First and second derivative tests
   g. Second derivative and concavity
   h. Asymptotes
10. Use differentiation to solve applications, such as related rate problems and optimization problems
   a. Local linearity and linear approximation
   b. Differentials
   c. Mean Value Theorem
   d. Related rates
   e. Optimization
   f. Velocity and acceleration
   g. Extreme Value Theorem
11. 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
12. Use technology, such as graphing calculators and/or computer software to assist in solving problems involving any of the topics in (1) through (11) above
   a. Calculator/computer utilities for evaluating derivatives
   b. Calculator/computer utilities for constructing graphs of derivatives
   c. Calculator/computer utilities for estimating limits numerically
   d. Calculator/computer utilities for verifying solutions to optimization problems
13. Discuss mathematical problems and write solutions in accurate mathematical language and notation
   a. Application problems from other disciplines
   b. Proper notation
14. Interpret mathematical solutions
   a. Interpretations of the derivative
   b. 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 I (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