MATH 1AH: HONORS CALCULUS I

Foothill College Course Outline of Record

Heading	Value
Effective Term:	Summer 2021
Units:	5
Hours:	5 lecture per week (60 total per quarter)
Prerequisite:	MATH 48C or equivalent.
Corequisite:	MATH 1AHP.
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 1A.
Degree & Credit Status:	Degree-Applicable Credit Course
Foothill GE:	Area V: Communication & Analytical Thinking
Transferable:	CSU/UC
Grade Type:	Letter Grade Only
Repeatability:	Not Repeatable

Student Learning Outcomes

- Use derivatives to graph, and to model and solve application problems using accurate mathematical notation
- Define, calculate with various techniques, and demonstrate an understanding of limits, derivatives, and simple antiderivatives using accurate mathematical notation.
- Use formal definitions and theorems with mathematical proof techniques to prove limits, derivative values, and relevant theorems.

Description

Introduction to differential calculus, including limits, derivatives and their applications to curve-sketching, families of functions, and optimization. Honors work emphasizes a deeper study of differential calculus via the study of proofs using analytic techniques, real-world problems, and special applied projects.

Course Objectives

The student will be able to:
A. Demonstrate an understanding of and calculate limits.
B. Demonstrate an understanding of and calculate first and second derivatives.
C. Graph using the derivative.
D. Apply techniques of differentiation.
E. Differentiate functions in polar and parametric form.
F. Demonstrate an understanding of applications of the derivative.
G. Define the antiderivative and determine antiderivatives of simple functions.
H. Use technology, such as graphing calculators and/or computer software to assist in solving problems involving any of the topics in (A) through (G) above.
I. Discuss mathematical problems and write solutions in accurate mathematical language and notation.
J. Interpret mathematical solutions.
K. Prove limits, derivatives, and theorems.

Course Content

A. Demonstrate an understanding of and calculate limits
1. One-sided and two-sided limits
2. Finding limits graphically
3. The limit laws
4. Evaluating limits
5. L'Hospital's Rule
6. Formal definition of a limit
7. Continuity
8. Intermediate Value Theorem
B. Demonstrate an understanding of and calculate first and second derivatives
1. Average and instantaneous rates of change
2. Slopes of secant and tangent lines
3. Equations of tangent lines
4. Continuity and differentiability
5. Optimization
6. The derivative at a point
7. The derivative function
8. Interpretations of the derivative
9. The second derivative and concavity
10. Applications to velocity and acceleration
C. Graph using the derivative
1. Critical points
2. Graphing polynomial functions using the derivative
3. Relative extrema
4. Global extrema
5. Inflection points
6. First and second derivative tests
7. Families of curves
8. Graphing functions using asymptotes
D. Apply techniques of differentiation
1. Power rule
2. Product rule
3. Quotient rule
4. Chain rule
5. Implicit differentiation
6. Derivatives of exponential functions
7. Derivatives of logarithmic functions
8. Derivatives of trigonometric functions
9. Derivatives of inverse functions
E. Differentiating functions in polar and parametric form
1. Tangents to parametric and polar curves
F. Demonstrate an understanding of applications of the derivative
1. Local linearity and linear approximation
2. Differentials
3. Mean Value Theorem
4. Rolle's Theorem
5. Newton's method for approximating roots
6. Related rates
7. Optimization
G. Define the antiderivative and determine antiderivatives of simple functions
1. Find general and particular antiderivatives
2. Antiderivatives in the context of rectilinear motion
3. Graphing antiderivatives

H. Use technology, such as graphing calculators and/or computer software to assist in solving problems involving any of the topics in (A) through (G) above
1. Calculator/computer utilities for evaluating derivatives
2. Calculator/computer utilities for constructing graphs of derivatives
3. Calculator/computer utilities for estimating limits numerically
4. Calculator/computer utilities for verifying solutions to optimization problems
I. Discuss mathematical problems and write solutions in accurate mathematical language and notation
1. Application problems from other disciplines
2. Proper notation
3. Correct mathematical proofs of certain limits, derivatives, and theorems
J. Interpret mathematical solutions
1. Explain the significance of solutions to application problems
2. Predict and explain solutions through models
K. In addition to all material covered in MATH 1A, the honors student in this course will do the following: Prove limits, derivatives, and theorems
1. Limits using epsilon-delta proofs
2. Derivative values using epsilon-delta proofs
3. Proofs of major theorems and rules
a. Mean Value Theorem
b. Intermediate Value Theorem
c. Limit laws
d. Derivative rules

Lab Content

Not applicable.

Special Facilities and/or Equipment

A. Access to graphing technology, such as a graphing calculator or graphing software.
B. Access to a mathematical typesetting software.

Method(s) of Evaluation

Written homework
Quizzes and tests
Proctored comprehensive final examination
Typed solutions to special applied projects with detailed explanations

Method(s) of Instruction

Lecture
Discussion
Cooperative learning exercises

Representative Text(s) and Other Materials

Briggs W., L. Cochran, and B. Gillett. Calculus Early Transcendentals, 3rd ed.. 2018.

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

A. Homework Problems: 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. Honors students will be assigned some of the more challenging problems from the textbook.
B. Lecture: Six hours per week of lecture covering subject matter from text and related material. Reading and study of the textbook, related materials and notes.
C. Special Applied Projects: Students will submit a typed report solving at least one applied, real-world problem. Typed solutions should be generated using a mathematical typesetting software. These special applied projects will require students to discuss mathematical problems, write solutions using accurate mathematical language and notation, and interpret mathematical solutions. Projects may require the use of a computer algebra system, such as Mathematica or MATLAB.
D. Worksheets: Problems and activities covering the subject matter. Such problems and activities will require students to think critically. These worksheets may be completed inside or outside of class.

Discipline(s)

Mathematics