MATH 1C: CALCULUS

Foothill College Course Outline of Record

Heading	Value
Effective Term:	Summer 2022
Units:	5
Hours:	5 lecture per week (60 total per quarter)
Prerequisite:	MATH 1B or 1BH.
Advisory:	Demonstrated proficiency in English by placement via multiple measures OR through an equivalent placement process OR completion of ESLL 125 & ESLL 249.
Degree & Credit Status:	Degree-Applicable Credit Course
Foothill GE:	Area V: Communication & Analytical Thinking
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 functions of multiple variables and series.
- Students will develop conceptual understanding of sequences and series and functions of multiple variables and their rates of change. 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 model lines and planes in space and calculate partial and directional derivatives of functions of multiple variables.

Description

Introduction to functions of more than one variable, including vectors, partial differentiation, the gradient, contour diagrams and optimization. Additional topics include infinite series, convergence and Taylor series.

Course Objectives

The student will be able to:

1. Analyze sequences and series.
2. Apply convergence tests to sequences and series.
3. Approximate functions using Taylor polynomials.
4. Investigate vectors, including dot and cross products.
5. Demonstrate the ability to work with functions of more than one variable, which includes topics such as limits, continuity, the limit of a function at a point, computing both the equation of a plane and the equation of a tangent plane to a surface at a point, and parametric and vector equations of lines in 3-space.
6. Differentiate functions of more than one variable, including the directional derivative, the gradient, the chain rule, and the determination of whether a function is differentiable.
7. Optimize functions of more than one variable for both constrained and unconstrained optimization problems; use of the second derivative test to find local extrema and test for saddle points.
8. Use technology, such as graphing calculators and/or computer software to assist in solving problems involving any of the topics in (1) through (7) above.
9. Discuss mathematical problems and write solutions in accurate mathematical language and notation.
10. Interpret mathematical solutions.

Course Content

1. Analyze sequences and series
   a. Sequences
      i. Convergence and divergence of sequences
      ii. Limits
      iii. Convergence theorems
   b. Series
      i. Geometric series
      ii. Alternating series
      iii. Power series
         1. Differentiation of power series
         2. Integration of power series
      iv. Applications to other disciplines
2. Apply convergence tests to sequences and series
   a. Convergence and divergence of series
   b. Tests for convergence
   c. Radius of convergence
   d. Interval of convergence
3. Approximate functions using Taylor polynomials
   a. Taylor polynomials
      i. Applications to other disciplines
      ii. Error in Taylor polynomial approximations
   b. Taylor series
      i. Finding and using Taylor series
      ii. Applications to other disciplines
4. Investigate vectors, including dot and cross products
   a. Displacement vectors
   b. Vectors operations in two-space and three-space
   c. Dot product
   d. Cross product
   e. Triple products
   f. Projections
   g. Applications to other disciplines
5. Demonstrate the ability to work with functions of more than one variable
   a. Functions of several variables
   b. Graphs of functions of several variables
   c. Lines in 3-space
      i. Parametric representations
      ii. Vector representations
   d. Contour diagrams
   e. Cross-sections
   f. Level curves
   g. Linear functions

      i. Rectangular equation of a plane
      ii. Equation of a tangent plane at a point
   h. Limits and continuity
      i. Limit of a function at a point
6. Differentiate functions of more than one variable, including the directional derivative, the gradient, and the chain rule
   a. Partial derivatives
      i. Definition
      ii. Algebraic computation
   b. Tangent planes
   c. Linear approximations
      i. Applications to other disciplines
   d. Gradients
      i. Applications to other disciplines
   e. Directional derivatives
      i. Applications to other disciplines
   f. The chain rule
      i. Applications to other disciplines
   g. Higher-order partial derivatives
   h. Differentiability
      i. Partial derivatives
      ii. Directional derivatives
      iii. Differentiability of a surface at a point
7. Optimize functions of more than one variable for both constrained and unconstrained optimization problems
   a. Local extrema
      i. Definitions
      ii. Second derivative test
         1. Local maximuma
         2. Local minima
         3. Saddle points
   b. Optimization
   c. Constrained optimization
      i. Lagrange multipliers
   d. Applications to other disciplines
8. Use technology, such as graphing calculators and/or computer software to assist in solving problems involving any of the topics in (1) through (7) above
   a. Calculator/computer utilities for solving problems involving sequences and series
   b. Calculator/computer utilities for constructing graphs of functions and relations in 3-space, contour diagrams, and graphs of cross-sections
   c. Calculator/computer programs for evaluating directional derivatives
9. Discuss mathematical problems and write solutions in accurate mathematical language and notation
   a. Application problems from other disciplines
   b. Proper notation
10. Interpret mathematical solutions
   a. Explain the significance of solutions to application problems

Lab Content

Not applicable.

Special Facilities and/or Equipment

Access to graphing technology, such as a graphing calculator or graphing software.

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

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

Alternative textbook: Calculus Volumes 2 & 3, OpenStax, 2020. https://openstax.org/subjects/math

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