MATH-1610: CALCULUS I

Cuyahoga Community College

Viewing: MATH-1610 : Calculus I

Board of Trustees:
June 2022

Academic Term:
Fall 2021

Subject Code
MATH - Mathematics

Course Number:
1610

Title:
Calculus I

Catalog Description:
First of a three-semester sequence designed for math, science, economics, and engineering majors. Includes an in-depth study and the articulation of the behavior of functions and their associated graphs. This study includes but is not limited to finite and infinite limits, continuity, differentiation and antidifferentiation of algebraic, trigonometric, logarithmic, exponential, and inverse trigonometric functions. Students will apply these concepts toward situational goals.

Credit Hour(s):
5

Lecture Hour(s):
5

Lab Hour(s):
0

Other Hour(s):
0

Requisites

Prerequisite and Corequisite
MATH-1540 Trigonometry or MATH-154H Honors Trigonometry, or MATH-1580 Precalculus, or qualified Math Placement, or departmental approval: equivalent coursework.

Outcomes

Course Outcome(s):
Demonstrate a deep understanding of the concepts of limit and continuity whether described verbally, numerically, graphically, or algebraically (both explicitly and implicitly).

Essential Learning Outcome Mapping:
Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.
Written Communication: Demonstrate effective written communication for an intended audience that follows genre/disciplinary conventions that reflect clarity, organization, and editing skills.
Quantitative Reasoning: Analyze problems, including real-world scenarios, through the application of mathematical and numerical concepts and skills, including the interpretation of data, tables, charts, or graphs.

Objective(s):
1. Analyze limits graphically and numerically.
2. Describe the limiting process with graphs of functions.
3. Produce/read tables of function values which illustrate limit properties.
4. Calculate limits algebraically.

5. Organize a well-formed presentation of the details involved in the limiting process via formulas.
6. Recognize and explain limits at infinity.
7. Furthers an understanding of infinity and how to logically work with unboundedness.
8. Communicate fluently about the concept of continuity.

Course Outcome(s):

Demonstrate an extensive understanding of the concept of differentiation from the details of specific procedures to the logical reasoning of abstracting relationships.

Essential Learning Outcome Mapping:

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.
Written Communication: Demonstrate effective written communication for an intended audience that follows genre/disciplinary conventions that reflect clarity, organization, and editing skills.
Quantitative Reasoning: Analyze problems, including real-world scenarios, through the application of mathematical and numerical concepts and skills, including the interpretation of data, tables, charts, or graphs.

Objective(s):

1. Apply the definition of the derivative to differentiate a function at a number and extend to an interval, choose appropriate differentiation rules and apply them, and parse formulas for application of the chain rule.
2. Operate the derivative as a tool.
3. Measure rates of change.
4. Utilize the derivative tool within the framework of a functional model.
5. Connect the slope of a tangent line with the value of the derivative.
6. Work with implicitly defined functions.

Course Outcome(s):

Fully analyze situations described by functions.

Essential Learning Outcome Mapping:

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.
Written Communication: Demonstrate effective written communication for an intended audience that follows genre/disciplinary conventions that reflect clarity, organization, and editing skills.
Quantitative Reasoning: Analyze problems, including real-world scenarios, through the application of mathematical and numerical concepts and skills, including the interpretation of data, tables, charts, or graphs.

Objective(s):

1. Identify critical numbers and extrema values.
2. Sketch curves/graphs of functions using derivatives and limits.
3. Optimize quantities in applied problems.

Course Outcome(s):

Reverse the differentiation process. Working symbolically, students recognize the algebraic result of the chain rule, parse expressions into pieces based on their compositional position, and formulate a reasonable antiderivative. Quickly apply the chain rule to their suggested antiderivative, identify differences, and effectively alter their antiderivative.

Essential Learning Outcome Mapping:

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.
Written Communication: Demonstrate effective written communication for an intended audience that follows genre/disciplinary conventions that reflect clarity, organization, and editing skills.
Quantitative Reasoning: Analyze problems, including real-world scenarios, through the application of mathematical and numerical concepts and skills, including the interpretation of data, tables, charts, or graphs.

Objective(s):

1. Understand the Fundamental Theorem of Calculus (FTC).
2. Create antiderivatives.
3. Fluency with the differentiation – antidifferentiation relationship.
4. Use the FTC.

5. Integrate functions by substitution.
6. Measure area of bounded planar regions.
7. Describe the situation in terms of functions and accompanying integration setup.

Methods of Evaluation:

1. Exams
2. Quizzes
3. Homework
4. Projects
5. Collaborative work

Course Content Outline:

1. Limits and continuity
   a. Informally define a limit
   b. Apply limit rules and theorems using correct notation throughout the process
   c. Algebraically manipulate a function to evaluate its limit
   d. Explain the rationale for and compute one-sided limits
   e. Communicate the difference between and compute infinite limits and limits at infinity
   f. Show how limits can lead to horizontal and vertical asymptotes
   g. Continuity and discontinuity of a function
   h. Theorems on continuity
2. The derivative
   a. Definition of the derivatives of a function
   b. Tangent lines
   c. Differentiability and continuity of functions
   d. Compute the derivatives, including the chain rule, of various functions:
      i. Algebraic functions
      ii. Trigonometric functions
      iii. Inverse trigonometric functions
      iv. Exponential functions
      v. Logarithmic functions
   e. Implicit differentiation and its role in evaluating the behavior of a multi-variable function
   f. Logarithmic differentiation
   g. Derivatives of higher order
3. Applications of the derivative
   a. The derivative as a rate of change
   b. Relative and absolute extrema
   c. Related rates
   d. L'Hôpital's Rule
   e. Rolle's Theorem
   f. Mean-Value Theorem
   g. Using derivatives to graph and communicate the behavior of functions
   h. Newton-Raphson method
   i. Optimization
   j. Differentials and linear approximations
4. Antidifferentiation
   a. The inverse of differentiation
   b. Finding anti-derivatives by substitution
   c. The definite integral and its applications
   d. Properties of the definite integral
   e. Integrals yielding the natural logarithmic function
   f. The Mean-Value Theorem for integrals
   g. The Fundamental Theorem of calculus and its applications
   h. Evaluate a definite integral using substitution and change of bounds

Resources

Larson, Ron and Bruce H. Edwards. *Calculus*. 9th ed. Cengage, 2019.

Anton, Bivens and Davis. *Calculus*. 11th ed. John Wiley & Sons, Inc., 2019.

Stewart, James; Clegg, Daniel; Watson, Saleem. *Calculus - Early Transcendentals*. 9th ed. Cengage, 2021.

Briggs, William; Cochran, Lyle; Gillett, Bernard; Schulz, Eric. *Calculus - Early Transcendentals*. 3rd ed. Pearson, 2019.

Resources Other

1. Textbook Software
2. Computer Algebra Systems: Maple, Mathematica, Derive and Converge

Instructional Services

OAN Number:

Ohio Transfer 36 TMM005 and TMM017 (1 of 2 courses, both must be taken)

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