MATH-161H: HONORS CALCULUS I

Cuyahoga Community College

Viewing: MATH-161H : Honors Calculus I

Board of Trustees:
2016-03-31

Academic Term:
Fall 2020

Subject Code
MATH - Mathematics

Course Number:
161H

Title:
Honors Calculus I

Catalog Description:
First of a three-semester sequence designed for math, science, business, and engineering majors. Focus on conceptual understanding of verbal, numerical, visual, and algebraic representations of functions, their graphs, and operations. Includes limits, continuity, rates of change, derivatives, implicit differentiation of algebraic and trigonometric functions, application of differentials, differentiation, integrals, and application of integration. Emphasizes challenging calculus exercises, problems, projects, cooperative group work, students presentation of one of the course projects, and use of technology: graphing calculators and computers.

Credit Hour(s):
5

Lecture Hour(s):
5

Requisites

Prerequisite and Corequisite
MATH-1540 Trigonometry or MATH-154H Honors Trigonometry or MATH-1580 Precalculus; or departmental approval: equivalent coursework.

Outcomes

Course Outcome(s):
Use algebra and technology to solve a variety of challenging exercises with equations and inequalities.

Course Outcome(s):
Use formulas of differentiation, the Chain Rule, and implicit differentiation to find derivatives and higher-order derivatives of various algebraic and trigonometric functions.

Course Outcome(s):
Apply derivatives as rates of change to solve various types of problems in the natural and social sciences: physics, chemistry, biology, economics and other sciences, including maxima and minima, related rates, mathematical optimization, and graphing functions; use analytical, graphical, and computer algebra system approaches.

Course Outcome(s):
Demonstrate use of linear approximation and differentials in a variety of estimating applications.

Course Outcome(s):
State, interpret, and apply the Mean Value Theorem to explore and solve problems.

Course Outcome(s):
Graph functions using horizontal and vertical asymptotes; investigate graphs.

Course Outcome(s):
Use systematic procedures to sketch a curve by the "pencil and paper method"; use graphing calculator/computer algebra systems for graphing.

Course Outcome(s):
Use Newton's method to approximate solutions of n th-degree equations.

Course Outcome(s):
Determine antiderivatives of algebraic functions.

Course Outcome(s):
State and interpret the Fundamental Theorem of Calculus and apply this theorem to real-life situations.

Course Outcome(s):
Apply the properties of definite integrals and critical thinking skills to solving a variety of challenging problems, including areas, volumes, lengths of curves, population predictions, cardiac output, forces on a dam, fluid pressure, and work.

Course Outcome(s):
Identify types of functions and their graphs from four ways of presentation: verbally, numerically, visually, and algebraically.

Course Outcome(s):
Explore and develop four projects--one each of applied, discovery, laboratory, and writing--to demonstrate comprehensive honors calculus' competencies and skills.

Course Outcome(s):
Enhance mathematical reasoning, decision-making, and problem-solving skills through research and small group activities.

Course Outcome(s):
Prove a variety of theorems and mathematics statements; derive and verify mathematical models.

Course Outcome(s):
Use technology: graphing calculator or computer algebra systems to graph, compute, evaluate, estimate, and develop projects.

Course Outcome(s):
Perform operations on functions: transformations, combinations, and compositions.

Course Outcome(s):
Apply problem-solving principles to real-life problems.

Course Outcome(s):
Describe the process of using functions as mathematical models.

Course Outcome(s):
Investigate limits and their properties.

Course Outcome(s):
Compute limits and solve advanced applications using special techniques and limit theorems.

Course Outcome(s):
Demonstrate use of the definition of continuity, continuity theorems, and decision-making skills in solving real-life problems.

Course Outcome(s):
Apply definition and interpretations of a derivative to solve challenging problems.

Methods of Evaluation:
1. Periodic comprehensive exams (at least four exams)
2. Quizzes
3. Homework
4. In class collaborative and cooperative group work
5. Four course projects: applied, discovery, laboratory, and writing
6. Student presentation of one of the above course projects
7. Graphing calculator/computer application problems Comprehensive final examI

Course Content Outline:
1. Fundamental concepts with technology
   a. Real number system and estimating strategies
   b. Equations and their graphs
   c. Applying the problem-solving principles, strategies, and skills to real-life problems
   d. Use of graphing calculator/computer algebra systems to solve challenging word problems
   e. Inequalities and their graphs
2. Functions and mathematical models
   a. Four ways of the function presentation: verbally, numerically, visually, and algebraically
   b. Linear models of functions and their graphs, characteristics, and use
   c. Polynomial functions and their graphs, characteristics, and use
   d. Power functions and their graphs, characteristics, and use
   e. Algebraic functions and their graphs, characteristics, and use
   f. Trigonometric functions and their graphs, characteristics, and use
   g. Transformation, combining, composition, and decomposition of functions and exploratory problems
   h. Use graphing calculator/computer algebra systems for graphing
3. Limits and their properties:
   a. The concept of limit and its graphical interpretation: tangent line and elocity problems
   b. Proof of limit theorems
   c. Analytical and graphical approaches to evaluate one-sided limits, limits at infinity, infinite limits of functions; solving advanced applications
   d. Limits of trigonometric functions; exploring and solving real-life situation problems
   e. Use of graphing calculator/computer algebra systems to calculate limits and solve challenging problems
   f. Continuity of the function; physical and geometric interpretation of continuity
   g. Proof of continuity theorems and applying decision-making skills to solving advanced applications
4. Derivatives and differentiation:
   a. Derivatives and their interpretations; the tangent line problems
   b. Proof of theorems of differentiability and continuity of functions
   c. Formulas of differentiation and higher-order derivatives
   d. Use of analytical approach and graphical analysis to solve physical applications of the derivative Differentiation of trigonometric functions
   e. The Chain Rule and solving exploration problems
   f. Implicit differentiation, higher derivatives, and their advanced applications
5. Applications and differentiation
   a. Rate of change and problem-solving applications
   b. Relative and absolute extrema and solving critical-thinking-skill applications

   c. Related rates and mathematical modeling
   d. Rolle''s theorem and the Mean Value Theorem and their graphical presentation and problem-solving applications
   e. Analysis of functions: using the First and Second Derivative Tests
   f. Limits at Infinity: Horizontal Asymptotes
   g. Use of graphing calculator/ computer algebra systems to sketch curves and analyze functions
   h. Solving optimization and economics problems
   i. Newton''s method of approximation of real solutions of polynomial equations
6. The differential and antiderivatives
   a. etermining differentials
   b. Antiderivatives, and their notation and geometric interpretations
   c. Challenging applications problems
7. The Definite Integral and Integration
   a. Summation formulas and Riemann sums: special notation and terminology The definite integral and its integration and applications
   b. Use graphing calculators/computer algebra systems to evaluate integrals
   c. Use area formula to evaluate integrals
   d. Properties of definite integrals and solving exploration problems The Fundamental Theorem of Calculus and solving decision-making-skill applications
   e. Trapezoidal and Simpson''s Rules and solving advanced applications
   f. Use mathematical reasoning skills to solve challenging applications of definite integrals: area, volumes, arc length, work, lengths of curves, population predictions, cardiac output, forces on a dam, work, value of function, surface area, and physical applications-by using graphing calculator/computeralgebra systems
8. Exploration of four projects-one from each category: applied, discovery, laboratory, and writing

Resources

Anton, H. Bivens, I. Davis S. *Calculus.* 7th. New York, NY: John Willey Sons, Inc., 2003.

Bradley G. Smith K. *Calculus.* 2nd. Upper Saddle River, NJ: Prentice Hall, 1999.

Edwards, C. H. Penney, D. E. (1998). *Calculus: Early trancendentals.* 6th. Upper Saddle River, NJ: Prentice Hall, 1998.

Gottlieb R. *Calculus: An integrated approach to functions and their rates of change.* Preliminary. Boston, MA: Addison Wesley, 2001.

Hughes-Hallet, D., Gleason, A., McCallum, W., et al. *Calculus: Single and multivariable.* 3rd. New York, NY: John Willey Sons, Inc., 0.

Larson, R., Hostetler, R. Edwards, B., Heyd. D. *Calculus with analytic geometry.* 7th. New York, NY: Houghton Mifflin Co., 2000.

Larson, R., Hostetler, R., Edwards. B. Heyd. D. *Calculus 1 with precalculus.* 7th. New York., NY: Houghton Mifflin Co., 2000.

Salas, Hille Etgen. *Calculus: One and several variables.* 8th. New York, NY: John Willey Sons, Inc., 1999.

Smith, R., Minton, R. *Calculus and Analytic Geometry.* 2nd. New York, NY: McGraw-Hill Companies, Inc., 2002.

Stewart, J. *Calculus.* 4th. Pacific Grove, CA: Brooks/Cole Published Co., 1999.

Strauss, M. Bradley, G., Smith, K. *Single variable calculus.* 3rd. Upper Saddle River, NJ: Prentice Hall, 1999.

Resources Other

1. The textbook''s software and a variety of computer algebra systems: Derive, Maple, Mathematica and others.
2. Mathematical articles from newspapers and mathematical journals.

Instructional Services

OAN Number:
Ohio Transfer Module TMM005 and TMM017 (1 of 2 courses, both must be taken)

Top of page
Key: 2859