Greenwich Public Schools Curriculum Overview

HONORS ADVANCED CALCULUS

Personalized learning is achieved through standards-based, rigorous and relevant curriculum that is aligned to digital tools and resources.

Note: Teachers retain professional discretion in how the learning is presented based on the needs and interests of their students.

Course Description

Honors Advanced Calculus
Full Year
028250 6 Blocks 1 Credit
Prerequisite: Advanced Placement Calculus BC and teacher recommendation.
The topics covered in this course include applications of integration, vectors in space and their applications, equations of surfaces, differentiation/integration and applications of vector-valued functions, functions of several variables, partial derivatives, multiple integration, some vector analysis, including an introduction to vector fields, and line integrals.

Unit Guide

Chapter 7: Applications of Integration
Chapter 10: Conics, Parametric Equations and Polar Equations
Chapter 11: Vectors and the Geometry of Space
Chapter 12: Vector Valued Functions
Chapter 13: Functions of Several Variables
Chapter 14: Multiple Integration
Chapter 15: Vector Analysis
Final Review & Final Exam*

***Note**: Semester exam review packets, answer keys and formula sheets can be found by joining our **Schoology** *Math Department Review Course*, using COURSE access code P9V9X-H6V37.

Mathematical Practices

- Make sense of problems and persevere in solving them.
- Reason abstractly and quantitatively.
- Construct viable arguments and critique the reasoning of others.
- Model with mathematics.
- Use appropriate tools strategically.
- Attend to precision.
- Look for and make use of structure.

Enduring Understandings

- *Chapter 7*:
    - Definite integrals allow us to solve problems involving the accumulation of change in length, area and volume over an interval
    - The definite integral is a tool that used with many applications including the calculation of work done by a force when moving an object, and finding the center of mass of a planar lamina
- *Chapter 10*:
    - The definitions of the cross sections of a cone expose important geometric properties of these curves, including ellipses, parabolas, circles and hyperbolas
    - The equations of the conic sections allow us to analyze these curves. Applications of these allow scientists to predict planetary motion.
    - Modelling conic section curves with polar equations gives us a simpler way of expressing the relationship between the changing variables
    - Parametric models for motion along two-dimensional curves allows us to associate a third variable with a location in two-space
- *Chapter 11*:
    - Many quantities (force, velocity, acceleration) cannot be expressed using a single measurement. Vectors which quantify magnitude as well as direction, give us the ability to express these.
    - Basic operations (addition, subtraction, scalar multiplication, dot product, cross product) on vectors are essential in being able to apply these to problem solving.
    - Analysis in three-dimensional space requires the development of new ways to express a set of points (lines, places, quadric surfaces) and the facility to manipulate these equations for analysis of these curves is essential for applications to follow
    - Other coordinate systems (cylindrical, spherical) can help to simplify the equations of surfaces
- *Chapter 12*:
    - Vector-valued functions allow us to express the path of motion through space
    - Derivatives of vector valued functions are useful to analyze the motion (velocity, speed, acceleration) of a point in space
    - The tangent and normal components of vectors help us to quantify curvature
    - Applications of vector valued functions are the basis of Kepler's Laws of Motion
- *Chapter 13*:
    - Physical quantities often depend on two or more variables. We extend the basic ideas of Calculus to such functions
    - Partial derivatives allow us to consider the rate of change of a function of multiple variables as one of the dependent variables changes
    - Partial derivatives are needed to write the equation of tangent planes, which can be used to predict the change in the function of two variables as one of both of the dependent variables change.
    - The gradient vector is useful in determining the greatest rate of change and the direction of this greatest rate of change of a function in three space
    - Functions of several variables can be analyzed for optimal values using gradients and the technique of LaGrange Multipliers.
- *Chapter 14*:
    - Definite integrals can be extended to double and triple integrals can be used to compute plane areas, volumes, area of a surfaces, masses and centroids

- *Chapter 15*:
    - Vector fields assign vectors to points in space
    - Line integrals an be used to find the work done by a force field in moving an object along a curve
    - Surface integrals can be used to find the rate of fluid flow across a surface

Essential Questions

- *Chapter 7*:
    - How do you use an integral to calculate surface area, volume and arc length?
    - How do you calculate work done by a force when moving an object? How do you find the center of mass of a planar lamina?
- *Chapter 10*:
    - What is the locus definition of an ellipse, parabola, circle and hyperbola?
    - How can you model these conic sections with equations in Cartesian Form? Polar Form?
    - How do parametric equations work together? How can you create a set of parametric equations to trace the path of a given curve?
- *Chapter 11*:
    - What is a vector?
    - How do you perform basic vector operations (addition, subtraction, scalar multiplication, dot product, cross product)?
    - How do you write the equations of lines, places, quadric surfaces?
    - How do you define cylindrical and spherical coordinates? How do you write equations of surfaces in these coordinate systems?
    - How do you convert between these three different coordinate systems?
- *Chapter 12*:
    - What is a Vector-valued function?
    - How do you take derivatives of vector valued functions and use them analyze the motion (velocity, speed, acceleration) of a point in space?
    - How do you compute the tangent and normal components of vectors and how can they help us to quantify curvature?
- *Chapter 13*:
    - How do you express a function of several variables? Why might you need to?
    - How do you take a partial derivative?
    - How can you apply a partial derivative to write the equation of a tangent plane?
    - What is a gradient vector? What is it useful for?
    - How do you optimize a function of multiple variables?
- *Chapter 14*:
    - What is an iterated integral?
    - How do you evaluate an iterated integral?
    - What are the applications of integrated integrals?
- *Chapter 15*:
    - What is a vector field?
    - What is a line integral and how do you evaluate it?
    - What is a surface integral and how do you evaluate it?
    - What are the applications of line and surface integrals?

Resources

Textbook Information: Calculus (AP Edition) 11e
Larson/Edwards
Cengage (2018)
ISBN 978-1-33728688-6

Quarterly Grading - Quarter Grades will be determined using the following components:

- Participation (includes Classwork) = 5%
- Preparation (includes Homework) = 5%
- Assessments (both Summative & Formative) = 90%