AP Calculus AB

Course Description:

The curriculum for this elective Advanced Placement course is developed from the College Board AP Curriculum for AB Calculus. Students will be exposed to and practice skills related to: function representations (numerically, graphically, analytical, and verbal); meaning of derivatives (rate of change and local linearity) and use to solve a variety of problems; meaning of definite integrals (as a limit of riemann sums and net accumulation of change) and use to solve a variety of problems; understand the relationship between derivative and definite integral as expressed in Fundamental Theorem of Calculus; communicating solutions verbally and in writing; model written descriptions of physical situations; use technology to solve problems; determine reasonableness of solutions; and gain an appreciation of Calculus as a body of knowledge. Grades are determined by formative questions and summative exams. Successful completion of the AP Exam in Calculus AB, a score of 3 or better, will generally result in college credit earned for Calculus AB. This information in this course overview outlines what students should understand and be able to do by the end of two trimesters.

Mastery Standards:

As written from College Board AP Curriculum for Calculus AB

Limits

Students must have a solid, intuitive understanding of limits and be able to compute one-sided limits, limits at infinity, the limit of a sequence, and infinite limits. They should be able to apply limits to understand the behavior of a function near a point and understand how limits are used to determine continuity.

Standard 1: Students will understand that the concept of a limit can be used to understand the behavior of functions.

Standard 2: Students will understand that continuity is a key property of functions that is defined using limits.

Derivatives

Students should be able to use different definitions of the derivative, estimate derivatives from tables and graphs, and apply various derivative rules and properties. Students should also be able to solve separable differential equations, understand and be able to apply the Mean Value Theorem, and be familiar with a variety of real-world applications, including related rates, optimization, and growth and decay models.

Standard 3: Students will understand that the derivative of a function is defined as the limit of a difference quotient and can be determined using a variety of strategies.

Standard 4: Students will understand that a function's derivative, which is itself a function, can be used to understand the behavior of the function.

Standard 5: Students will understand that the derivative has multiple interpretations and applications including those that involve instantaneous rates of change.

Standard 6: Students will understand that the Mean Value Theorem connects the behavior of a differentiable function over an interval to the behavior of the derivative of that function at a particular point in the interval.

Integrals and the Fundamental Theorem of Calculus

Students should be familiar with basic techniques of integration, including basic antiderivatives and substitution, and properties of integrals. Students should also understand area, volume, and motion applications of integrals, as well as the use of the definite integral as an accumulation function. It is critical that students understand the relationship between integration and differentiation as expressed in the Fundamental Theorem of Calculus.

Standard 7: Students will understand that antidifferentiation is the inverse process of differentiation.

Standard 8: Students will understand that the definite integral of a function over an interval is the limit of a Riemann sum over that interval and can be calculated using a variety of strategies.

Standard 9: Students will understand that the Fundamental Theorem of Calculus, which has two distinct formulations, connects differentiation and integration.

Standard 10: Students will understand that the definite integral of a function over an interval is a mathematical tool with many interpretations and applications involving accumulation.

Standard 11: Students will understand that antidifferentiation is an underlying concept involved in solving separable differential equations. Solving separable differential equations involves determining a function or relation given its rate of change.

Unit	Description of Unit and Learning Targets
Unit 1: Properties of Limits Essential Questions: ● Can change occur at an instant? ● How does knowing the value of a limit, or that one does not exist, help you make sense of interesting features of functions and graphs?	Learning Targets: ● I can understand limit notation and evaluate limits graphically, numerically, and algebraically. ● I can understand and apply the definition of continuity. ● I can draw conclusions about a function's behavior on an interval using the Intermediate Value Theorem and Extreme Value Theorem..
Unit 2: Differentiation: Definition and Fundamental Properties Essential Questions: ● Why do mathematical properties and rules for simplifying and evaluating limits apply to differentiation? ● How is the average rate of change related to instantaneous rate of change? ● How are derivatives related to continuity and the tangent line on a curve?	Learning Targets: ● I can find the average rate of change and instantaneous rate of change at a point. ● I can recognize and apply the limit definition of the derivative. ● I can find the derivative of a function using basic differentiation rules (power rule, constant, sum, difference, constant multiplication). ● I can compute derivatives of sine and cosine functions.
Unit 3: Differentiation: Composite, Implicit, and Inverse Functions Essential Questions: ● How do the derivative rules relate to each other? ● How do the rates of change relate to real life situations? ● How are equations of tangent lines related to linearization problems?	Learning Targets: ● How to find derivatives using Products and Quotient Rules. ● Find derivatives of tangent and inverse tangent functions. ● Solve problems involving related rates and implicit differentiation.. ● Solve problems involving related rates of change in applied contexts. ● Finding equations of tangent lines.
Unit 4: Definite and Indefinite Integrals Essential Questions: ● How do basic shapes in Geometry help us estimate areas in Calculus? ● How are properties of definite Integrals related to Riemann Sum definition? ● How does the Mean Value Theorem justify conclusion in application problems?	Students will... Learning Targets: ● Determine the applicability of the Mean Value Theorem using continuity. ● Apply the Mean Value Theorem to describe the behavior of a function over an interval. ● Recognize antiderivatives of basic functions. ● Interprete the definite integral as the limit of a Riemann sum. ● Express the limit of a Riemann sum in integral notation. ● Approximate a definite Integral

● How can integrals be used to find area and volume? ● How does Fundamental Theorem of Calculus connect derivatives and integrals?	● Calculate a definite integral using areas and properties of definite integrals. ● Apply definite integrals to problems involving area and volume. ● Use the definite integrals to solve problems in various context.
Unit 5: Calculus of Logarithmic and Exponential Functions Essential Questions: ● How do you use the definite integral as an accumulating function (Fundamental Theorem of Calculus part 2)? ● In what ways are the transcendental functions supported by calculus? ● How do derivatives help with indeterminate limits?	Students will... Learning Targets: ● Use the definite integral to determine how much change in a function has occurred (the accumulating function). ● Use calculus to determine a particles rectilinear motion. ● Differentiate logarithmic and exponential functions. ● Determine when l'Hospital's is appropriate to use and apply it when finding limits.
Unit 7: Differential Equations Essential Questions: ● In what ways are differential equations related to real world problems? ● How do slope fields relate to differential equations?	Students will... Learning Targets: ● Estimate and verify solutions to differential equations. ● Make connections between slope fields and functions. ● Analyze differential equations to obtain general and specific solutions. ● Interpret, create, and solve differential equations from problems in context.
Unit 8: Calculus of Plane and Solid Figures Essential Questions: ● How do derivatives relate to properties of a function graph? ● How do derivatives help solve optimization problems?	Students will... Learning Targets: ● Use derivatives to analyze properties of functions (maximums and minimums). ● Use the first derivative to tell whether a function is increasing or decreasing and the second derivative to tell the concavity of the function. ● Optimize plane and solid figures.
Unit 10:Particles in Motion Essential Questions: ● What is the difference between displacement and distance and how are integrals are written to find each?	Students will... Learning Targets: ● Solve problems involving optimization and rectilinear motion.