AP Calculus

Grade Level:	12(with Recommendation)
Length:	1 Year
Period(s) Per Day:	1
Credit:	1
Credit Requirement Fulfilled:	N/A
Text:	James Stewart : *Calculus Eighth Edition*

Course Description:

AP Calculus is a course designed to meet the College Board Advanced Placement AB standards. Students are expected to take the AP test for Calculus AB at the end of the year. This is a very challenging mathematics course, being the equivalent of one semester of college calculus. Students entering the class should have performed strongly in Algebra 2 and Trig & Calc.

The main instructional technique will be group lecture, with students writing down notes, examples, and working out practice problems throughout the lesson. Discussing how topics are related to each other through activities will provide a necessary connection that we can use to fuel further lessons. Use of graphing calculators (TI-89) will also be necessary to interpret difficult functions and data sets and to test hypothesis about functions and their behavior.

Our class will focus on the 3 Big Ideas of Calculus (Limits, Derivatives, and Integrals), and will achieve a deep understanding of these ideas by applying the Mathematical Practices for AP Calculus. By mastering the 3 Big Ideas of Calculus (Limits, Derivatives, and Integrals), students will be able to view the world through the eyes of calculus to appreciate the beauty and application of higher-order mathematics.

Theme Samples:

1. Limits and Continuity

2. Differentiation: Definition and Basic Derivative Rules

3. Differentiation: Composite, Implicit, and Inverse Functions

4. Contextual Applications of Derivatives

5. Analytical Applications of Differentiation

6. Integration and Accumulation of Change

7. Differential Equations

8. Applications of Integration

Course Objectives and Expectations:

LO 1.1A(a) Students will be able to express limits symbolically using correct notation.

LO 1.1A(b) Students will be able to interpret limits expressed symbolically.

LO 1.1B Students will be able to estimate limits of functions.

LO 1.1C Students will be able to determine limits of functions.

LO 1.1D Students will be able to deduce and interpret behavior of functions using limits.

LO 1.2A Students will be able to analyze functions for intervals of continuity or points of discontinuity.

LO 1.2B Students will be able to determine the applicability of important calculus theorems using continuity.

LO 2.1A Students will be able to identify the derivatives of a function as the limit of a difference quotients.

LO 2.1B Students will be able to estimate derivatives.

LO 2.1C Students will be able to calculate derivatives.

LO 2.1D Students will be able to determine higher order derivatives.

LO 2.2A Students will be able to use derivatives to analyze properties of a function.

LO 2.2B Students will be able to recognize the connection between differentiability and continuity.

LO 2.3A Students will be able to interpret the meaning of a derivatives within a problem.

LO 2.3B Students will be able to solve problems involving the slope of a tangent line.

LO 2.3C Students will be able to solve problems involving related rates, optimization, and rectilinear motion.

LO 2.3D Students will be able to solve problems involving rates of change in applied contexts.

LO 2.3E Students will be able to verify solutions to differential equations.

LO 2.3F Students will be able to Estimate solutions to differential equations.

LO 2.4A Students will be able to apply the Mean Value Theorem to describe the behavior of a function over an interval.

LO 3.1A Students will be able to recognize antiderivatives of basic functions.

LO 3.2A(a) Students will be able to interpret the definite integral as the limit of a Riemann sum.

LO 3.2A(b) Students will be able to express the limit of a Riemann sum in integral notation.

LO 3.2B Students will be able to approximate a definite integral.

LO 3.2C Students will be able to calculate a definite integral using areas and properties of definite integrals.

LO 3.3A Students will be able to analyze functions defined by an integral.

LO 3.3B(a) Students will be able to calculate antiderivatives.

LO 3.3B(b) Students will be able to evaluate definite integrals.

LO 3.4A Students will be able to interpret the meaning of a definite integral within a problem.

LO 3.4B Students will be able to apply definite integrals to problems involving the average value of a functions.

LO 3.4C Students will be able to apply definite integrals to problems involving motion.

LO 3.4D Students will be able to apply definite integrals to problems involving area and volume.

LO 3.4E Students will be able to use the definite integral to solve problems in various contexts.

Mathematical Practices for AP Calculus (MPACs)

MPAC 1: Reasoning with definitions and theorems

Students can:

a. Use definitions and theorems to build arguments, to justify conclusions or answers, and to prove results.
b. Confirm that hypotheses have been satisfied in order to apply the conclusion of a theorem.
c. Apply definitions and theorems in the process of solving a problem.
d. Interpret quantifiers in definitions and theorems (e.g., "for all," "there exists").
e. Develop conjectures based on exploration with technology.
f. Produce examples and counterexamples to clarify understanding of definitions, to investigate whether converses of theorems are true or false, or to test conjectures.

MPAC 2: Connecting concepts

Students can:

a. Relate the concept of a limit to all aspects of calculus.
b. Use the connection between concepts (e.g., rate of change and accumulation) or processes (e.g., differentiation and its inverse process, antidifferentiation) to solve problems.
c. Connect concepts to their visual representations with and without technology.
d. Identify a common underlying structure in problems involving different contextual situations.

MPAC 3: Implementing algebraic/computational processes

Students can:

a. Select appropriate mathematical strategies.
b. Sequence algebraic/computational procedures logically.
c. Complete algebraic/computational processes correctly.
d. Apply technology strategically to solve problems.
e. Attend to precision graphically, numerically, analytically, and verbally and specify units of measure.
f. Connect the results of algebraic/computational processes to the question asked.

MPAC 4: Connecting multiple representations

Students can:

a. Associate tables, graphs, and symbolic representations of functions.
b. Develop concepts using graphical, symbolical, verbal, or numerical representations with and without technology.
c. Identify how mathematical characteristics of functions are related in different representations.
d. Extract and interpret mathematical content from any presentation of a function (e.g., utilize information from a table of values).
e. Construct one representational form from another (e.g., a table from a graph or a graph from given information).
f. Consider multiple representations (graphical, numerical, analytical, and verbal) of a function to select or construct a useful representation for solving a problem.

MPAC 5: Building notational fluency

Students can:

a. Know and use a variety of notations.
b. Connect notation to definitions (e.g., relating the notation for the definite integral to that of the limit of a Riemann sum).
c. Connect notation to different representations (graphical, numerical, analytical, and verbal).
d. Assign meaning to notation, accurately interpreting the notation in a given problem and across different contexts.

MPAC 6: Communicating

Students can:

a. Clearly present methods, reasoning, justifications, and conclusions.
b. Use accurate and precise language and notation.

c. Explain the meaning of expressions, notation, and results in terms of a context (including units).
d. Explain the connections among concepts.
e. Critically interpret and accurately report information provided by technology.
f. Analyze, evaluate, and compare the reasoning of others.

Pacing:

Semester 1
1. Limits and Continuity

2. Differentiation: Definition and Basic Derivative Rules

3. Differentiation: Composite, Implicit, and Inverse Functions

4. Contextual Applications of Derivatives

5. Analytical Applications of Differentiation

Semester 2
6. Integration and Accumulation of Change

7. Differential Equations

8. Applications of Integration

9. Review for AP Exam

Timeline:

Unit 1	(4 weeks to cover)
Unit 2	(4 weeks to cover)
Unit 3	(3 weeks to cover)
Unit 4	(2 weeks to cover)
Unit 5	(4 weeks to cover)
Unit 6	(6 weeks to cover)
Unit 7	(3 weeks to cover)
Unit 8	(3 weeks to cover)
Review for AP Exam	(4-6 weeks to cover)

Resources:
Text: James Stewart : *Calculus Eighth Edition*