AP Calculus Syllabus

2016-2017 School Year

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General Information

Course Description

AP Calculus AB is a college-level course designed for high school students. Most colleges and universities accept a passing score to count for credit as a completion of the Calculus I course. By completing this course, students will be able to:

- Work with functions whether they are presented graphically, numerically, analytically, or verbally;
- Understand and use derivatives;
- Understand and use definite integrals and Riemann sums;
- Understand the Fundamental Theorem of Calculus;
- Communicate mathematics and explains their solutions;
- Model physical situations with functions, differential equations, or integrals;
- Use technology to solve problems, experiments, interpret results, and support conclusions;
- Determine the reasonableness of solutions using various heuristics; and
- Develop an appreciation of calculus as a coherent body of knowledge and as a human accomplishment.

Expectations and Goals

Students are expected to be in class, prepared to learn and participate fully. Students are encouraged to ask questions of the teacher and each other when they do not understand something. Online resources must be approved by teacher for use.

The Rule of Four

Current mathematical education practices emphasize the "Rule of Four" approach to solve problems. The four branches of problem-solving are:

- Numerical analysis (where data points are known, but not an equation)
- Graphical analysis (where a graph is known, but not an equation)
- Analytical/algebraic analysis (traditional equations and manipulations)
- Verbal/written methods of representing problems (word problems and written justification of one's method in solving a problem)

Academic Grading Policy

Grades will be updated at least once per week.

50% of the student’s grades will be based on **chapter tests**

35% of the student's grades will be based on **quizzes and assignments**

15% of the student’s grades will be based on **active participation in class**

You will receive letter grades based upon the following percentages

A	100-95%
A-	94-93%
B+	92-90%
B	89-87%
B-	86-84%
C+	83-81%
C	80-78%
C-	77-75%
D+	74-72%
D	71-69%
D-	68-66%
F	65% AND BELOW

Retake Policy

Students will be allowed to correct missed problems on exams for 50% of original credit. Corrections must include explanations of how to original error was made, and why the correction follows the proper method of solving the problem.

Make-up/Late Policy

Any student who missed is responsible for the work and learning done while they were absent. Therefore, students who are absent are required to learn the material and complete the work that they miss as soon as possible. Work that has been missed will be given a score of (M) to indicate its absence.

If a student is not able to complete an assignment by the posted deadline, students have seven (7) days from the original due date until they receive a zero percent (0%). An assignment handed in during this window is eligible for a maximum score of eighty percent (80%).

Course Schedule

Unit 1: Limits and Continuity [CR1a]

1. Rates of Change
    a. Average Speed
    b. Instantaneous Speed
2. Limits at a point
    a. 1-sided limits
    b. 2-sided limits
    c. Sandwich theorem
3. Limits involving infinity
    a. Asymptotic behaviour
    b. End behavior models
    c. Properties of limits (algebraic analysis)
    d. Visualizing limits (graphic anaylsis)
4. Continuity
    a. Continuity at a point
    b. Continuous functions
    c. Discontinuous functions
        i. Removable continuity
        ii. Jump discontinuity
        iii. Infinite discontinuity
5. Rates of change and tangent lines
    a. Average rate of change
    b. Tangent lines to a curve
    c. Slope of curve (algebraically and graphically)
    d. Normal line to a curve (algebraically and graphically)
    e. Instantaneous rate of change

[CR1a] - This course is structured around the enduring understandings within Big Idea 1: Limits

Unit 2: The Derivative [CR1b]

1. Derivative function
    a. Definition of the derivative (difference quotient)

    b. Derivative at a point
    c. Relationships between the graphs *f* and *f'*
    d. Graphing a derivative from data
    e. One-sided derivatives
2. Differentiability
    a. Cases where *f'(x)* might fail to exist
    b. Local linearity
    c. Derivatives on the calculator
    d. Symmetric difference quotient
    e. Relationship between differentiability and continuity
3. Rules of Differentiation
    a. Constant, power, sum, difference, product, quotient rules
    b. Higher-order derivatives
4. APplications of the Derivative
    a. Position, velocity, acceleration, and jerk
    b. Particle motion
    c. L'Hospital's Rule
    d. Derivatives of trigonometric functions
    e. Chain Rule
    f. Implicit differentiation
        i. Differential method
        ii. *y'* method
    g. Derivatives of inverse trigonometric functions
    h. Derivatives exponential and logarithmic functions

[CR1b] - This course is structured around the enduring understandings with Big Idea 2: Derivatives

Unit 3: Application of the Derivative

1. Extreme values
    a. Relative extrema
    b. Absolute Extremes
    c. Extreme Value Theorem
    d. Definition of a critical point
2. Implications of the derivative

    a. Rolle's theorem
    b. Mean Value Theorem
    c. Increasing and decreasing functions
3. Connecting *f'* and *f''* with the graph *f(x)*
    a. First derivative test for relative max/min
    b. Second derivative
        i. Concavity
        ii. Inflection points
        iii. Second derivative test for relative max/min
4. Optimization problems
5. Linearization models
    a. Local linearization
    b. Tangent line approximation
    c. Differentials
6. Related Rates

Unit 4: The Definite Integral [CR1c]

1. Approximation areas
    a. Riemann sums
        i. Left sums
        ii. Right sums
        iii. Midpoint Sums
        iv. Trapezoidal sums
        v. Simpson's Rule
    b. Definite Integrals
2. Properties of definite integrals
    a. Power rule
    b. Mean Value Theorem for definite integrals
3. The Fundamental Theorem of Calculus
    a. Part 1
    b. Part 2

[CR1c] - This course is structured around Big Idea 3: Integrals and the Fundamental Theorem of Calculus

Unit 5: Differential Equations and Mathematical Modeling

1. Slope fields
2. Antiderivatives
    a. Indefinite integrals
    b. Power formulas
    c. Trigonometric formulas
    d. Exponential and logarithmic formulas
3. Separable differential equations
    a. Growth and Decay
    b. Slope fields
    c. General differential equations
    d. Newton's Law of Cooling
4. Logistic Growth

Unit 6: Application of Definite Integrals

1. Integral as net change
    a. Calculating distance traveled
    b. Consumption over time
    c. Net change from data
2. Area between curves
    a. Area between a curve and an axis
        i. Integrating with respect to x
        ii. Integrating with respect to y
    b. Area between intersecting curves
        i. Integrating with respect to x
        ii. Integrating with respect to y
3. Calculating Volume
    a. Cross sections
    b. Disc Method
    c. Shell method

Unit 7: Review/Test Preparation

1. Multiple-choice practice

    a. Test-taking strategies will be emphasized
    b. Individual and group practice will be utilized
2. Free-response practice (must include written explanations of methodology)
    a. Rubrics will be reviewed so that students see the need for complete answers
    b. Students will collaborate to formulate team responses
    c. Individually written responses are crafted. Attention to full explanations is emphasized

Unit 8: After the Exam

1. Projects designed to incorporate this year's learning with respect to career field applications
2. Research projects on the historical development of mathematics with a focus of calculus
3. Advanced integration techniques
    a. Integration by parts
    b. Integration by trigonometric substitution
4. A look at college math requirements and expectations, including necessary placement exams in regards to particular student-institution pairings

Mathematical Practices

The following is a brief description of some of the activities included in the course.

I. Reasoning with definitions and theorems

In problems involving direct use of definitions or theorems, students are asked to describe their processes in writing or algebraically. Additionally, we conduct discussions based upon the "Write to Learn" problems from multiple sections of the textbook. We also conduct in-class hands on experiences involving relating graphs, functions and definitions of the relationships between *f*, *f'*, and *f''*. **[CR2a]**

II. Connecting with concepts and processes

Connections between the functions of functions, their derivative and their integral are regularly made. After using algebraic means to solve for derivatives, antiderivatives, or values where a function is increasing, decreasing, or concavity, students are asked to verbally explain why the method or process justifies the algebra or graphic. Students used information to sketch the graph *f(x)* based on an initial value and an *f'(x)* graph. **[CR2b] [CR2d]**

III. Implementing algebraic/computational processes

Students spend a large amount of time working to solve problems from the text. Cooperation and communication is not only encouraged but expected. Students used tables of data to create regression models within their calculators and then use those models to solve story problems. Students also learn to solve Riemann sums by hand and compare to the Trapezoid rule values. **[CR2c] [CR3b] [CR3c]**

IV. Building notational fluency

Students are introduced to notation aspects such as **dy/dx**, growth and decay modeling, rates of change, summation notation and its relationship with calculus, continuously compounded interest, and Newton's Law of Cooling. Time is taken to describe each element of theoretical definitions. Proper notation usage is required during the process of solving equations, step-by-step. **[CR3e]**

V. Communicating

Throughout this course, students will be required to describe their processes, demonstrate them to one another, and explain further understandings on homework problems. Sharing knowledge is part of the participation expectations of this course. **[CR3f]**

Course Materials

Textbook

Finney, Watts, Demana, Kennedy. *Calculus: Graphical, Numerical, Algebraic*. AP Edition. 3rd ed. 2007. **[CR4]**

Calculator

A TI-Nspire CX Graphing Calculator is provided to all students involved in course. A signed slip of permission is required in order to borrow calculators from the school. Calculator will be used regularly to analyze and solve problems. Emphasis will be placed on evaluation of derivative, integrals, graphing of the same and graphing of slope fields and 3-dimensional spaces will also be covered. **[CR3a] [CR3b]**

Curricular Requirements

CR1a The course is structured around the enduring understandings with Big Idea 1: Limits

CR1b The course is structured around the enduring understandings with Big Idea 2: Derivatives

CR1c The course is structured around the enduring understandings within Big Idea 3: Integrals and the Fundamental Theorem of Calculus

CR2a The course provides opportunities for students to reason with definitions and theorems

CR2b The course provides opportunities to connect with concepts and processes

CR2c The course provides opportunities for students to implement algebraic/computational processes

CR2d The course provides opportunities for students to engage with graphical, numerical, analytical, and verbal representations and demonstrate connections among them

CR2e The course provides opportunities for students to build notational fluency

CR2f The course provides opportunities for students to communicate mathematical ideas in words, both orally and in writing

CR3a Students have access to graphing calculators

CR3b Students have opportunities to use calculators to solve problems

CR3c Students have opportunities to use a graphing calculator to explore and interpert concepts

CR4 Students and teachers have access to a college-level textbook