***AP Calculus AB Syllabus***

***2021 - 2022***

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**COURSE DESIGN AND PHILOSOPHY**:

Students do best when they understand the conceptual underpinnings of calculus. Rather than making the course a long laundry list of skills that students must memorize, I stress the “why’ behind the major ideas. If students can grasp the reasons for an idea or theorem, they can usually figure out how to apply it to the problem at hand. I explain to them that they will study four major ideas during the year: limits, derivatives, indefinite integrals, and definite integrals. As we develop the concepts, I explain how the mechanics go along with the topics.

**TEACHING STRATEGIES:**

During the first few weeks, I spend extra time familiarizing students with their graphing calculators. Students are taught the rule of four: Ideas can be investigated analytically, graphically, numerically, and verbally. Students are expected to relate the various representations to each other.

It is important for them to understand that graphs and tables are not sufficient to prove an idea. Verification always requires an analytic argument. Each chapter exam includes one or two questions that involve only graphs or numerical data.

I believe it is important to maintain a high level of student expectation. I have found that students will rise to the level that I expect of them. A teacher needs to have more confidence in the students than they have in themselves.

I also stress communication as a major goal of the course. Students are expected to explain problems using proper vocabulary and terms.

Much of calculus depends on an understanding of a concept taught in a previous lesson. Students are encouraged to form study groups and tutor themselves.

**CALCULATOR USAGE:**

The graphing calculator is required for class and used to help students develop an intuitive feel for concepts before they are approached through typical algebraic techniques.

Throughout the course, the limitations of the calculator are shown so students realize that they must be critical of solutions provided by the calculator i.e. f’(0) of |x| does not exist, but the calculator solution will be 0 due to the calculator’s use of symmetric difference quotient with a value for h other than zero.

I use the calculator as a tool to illustrate ideas and topics. I stress the four required functionalities of graphing technology:

1. Finding a root, or zero, of a function

2. Sketching a function in a specified window

3. Approximating the derivative at a point using numerical methods

4. Approximating the value of a definite integral using numerical methods

The calculator is also an excellent tool for checking work that was completed analytically.

**AP Calculus AB Course Outline**

Unit 1: Precalculus Review (2–3 weeks)

A. Lines

1. Slope as rate of change

2. Parallel and perpendicular lines

3. Equations of lines

B. Functions and graphs

1. Functions

2. Domain and range

3. Families of function

4. Piecewise functions

5. Composition of functions

C. Exponential and logarithmic functions

1. Exponential growth and decay

2. Inverse functions

3. Logarithmic functions

4. Properties of logarithms

D. Trigonometric functions

1. Graphs of basic trigonometric functions

a. Domain and range

b. Transformations

c. Inverse trigonometric functions

2. Applications

Unit 2: Limits and Continuity (3 weeks)

A. Rates of change

B. Limits at a point

1. Properties of limits

2. Two-sided

3. One-sided

C. Limits involving infinity

1. Asymptotic behavior

2. End behavior

3. Properties of limits

4. Visualizing limits

D. Continuity

1. Continuous functions

2. Discontinuous functions

a. Removable discontinuity

b. Jump discontinuity

c. Infinite discontinuity

E. Instantaneous rates of change

Unit 3: The Derivative (5 weeks)

A. Definition of the derivative

B. Differentiability

1. Local linearity

2. Numeric derivatives using the calculator

3. Differentiability and continuity

C. Derivatives of algebraic functions

D. Derivative rules when combining functions

E. Applications to velocity and acceleration

F. Derivatives of trigonometric functions

G. The chain rule

H. Implicit derivatives

1. Differential method

2. *y*' method

I. Derivatives of inverse trigonometric functions

J. Derivatives of logarithmic and exponential functions

Unit 4: Applications of the Derivative (4 weeks)

A. Extreme values

1. Local (relative) extrema

2. Global (absolute) extrema

B. Using the derivative

1. L’Hospital’s Rule

2. Mean Value Theorem

3. Rolle’s Theorem

4. Increasing and decreasing functions

5. Newton’s Method

C. Analysis of graphs using the first and second derivatives

1. Critical values

2. First derivative test for extrema

3. Concavity and points of inflection

4. Second derivative test for extrema

D. Optimization problems

E. Linearization models

F. Related rates

Winter break

Unit 5: The Definite Integral (3 weeks)

A. Approximating areas

1. Riemann sums

2. Trapezoidal rule

3. Definite integrals

B. The Fundamental Theorem of Calculus (part 1)

C. Definite integrals and antiderivatives

1. The Average Value Theorem

D. The Fundamental Theorem of Calculus (part 2)

Unit 6: Differential Equations and Mathematical Modeling (3-4 weeks)

A. Antiderivatives

B. Integration using *u*-substitution

C. Separable differential equations

1. Growth and decay

2. Slope fields

3. General differential equations

Unit 7: Applications of Definite Integrals (3 weeks)

A. Summing rates of change

B. Particle motion

C. Areas in the plane

D. Volumes

1. Volumes of solids with known cross sections.

2. Volumes of solids of revolution

a. Disk method

b. Shell method

This schedule leaves 4–6 weeks for review and flexibility with teaching and learning time management.

Major Text

Finney, Franklin D. Demana, Bert K. Waits, and Daniel Kennedy, David M. Bressoud. *Calculus—Graphical, Numerical, Algebraic.* 5th  ed. Boston: Pearson Prentice Hall, 2016.