**AP Calculus Course Syllabus**

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**Course Description:**

Calculus is the mathematics of change—velocities and accelerations—along with tangent lines, slopes, areas, volumes, arc lengths, centroids, curvatures, and a variety of other concepts that enable scientists, engineers, and economists to model real world situations *(—Mr. Leckie, 2014).* This course is designed to enable students to appreciate the beauty of calculus and will give students the tools to succeed in future college mathematics courses. Students are aware the course load is above average for Advanced Placement Courses, and giving the required effort will be beneficial.

***Every student taking AP Calculus will take the Advanced Placement Exam in May, in order to earn credit.***

**Textbook:**

Finney, Demana, Waits and Kennedy. *Calculus – Graphical, Numerical, Algebraic*. Third edition. Pearson, Prentice Hall, 2007.

**Materials:**

* Notebook
* Pencil
* Graph paper
* Graphing Calculator: I will use a Texas Instruments 84 Plus graphing calculator in class regularly. You will need a graphing calculator too. I recommend the TI – 84 or the TI – 83. I will not have calculators available for you to use.

We will use the calculator in a variety of ways including:

* Conduct explorations
* Graph functions within arbitrary windows
* Solve equations numerically
* Analyze and interpret results
* Justify and explain results of graphs and equations

**Flipped Classroom:**

We will be a flipped-classroom, which means lectures and notes will be done at home via Internet.

The flipped website is: [**http://www.chaoticgolf.com/vodcasts.html**](http://www.chaoticgolf.com/vodcasts.html)

Class time will be devoted to working on assignments, quizzes, and tests.

**Objectives:**

By successfully completing this course, you will be able to:

* Work with functions represented in a variety of ways and understand the connections among these representations.
* Understand the meaning of the derivative in terms of a rate of change and local linear approximation, and use derivatives to solve a variety of problems.
* Understand the relationship between the derivative and the definite integral.
* Communicate mathematics both orally and in well-written sentences to explain solutions to problems.
* Model a written description of a physical situation with a function, a differential equation, or an integral.
* Use technology to help solve problems, experiment, interpret results, and verify conclusions.
* Determine the reasonableness of solutions, including sign, size, relative accuracy, and units of measurement.
* Develop an appreciation of calculus as a coherent body of knowledge and as a human accomplishment.

**A Balanced Approach**

Current mathematical education emphasizes a “Rule of Four.” There are a variety of ways to approach and solve problems. The four branches of the problem-solving tree of mathematics are:

* Numerical analysis (where data points are known, but not an equation)
* Graphical analysis (where a graph is known, but again, not an equation)
* Analytic/algebraic analysis (traditional equation and variable manipulation)
* Verbal/written methods of representing problems (classic story problems as well as written justification of one’s thinking in solving a problem- such as on our state assessment)

**Outline**:

Homework will be turned in at the end of each chapter and graded for completion. Expect at least one quiz per chapter and an exam at the end of the chapter; a first semester final, and the AP test in May. (Schedule is tentative due to unforeseen circumstances.) (1 block = 90 min)

**Unit 1: Prerequisites for Calculus (9 blocks)**

1. 1.1 Lines (1 block)
   1. Slope
   2. Parallel and Perpendicular
   3. Equations of lines
2. 1.2 Functions and Graphs (1 block)
   1. Domain and Range
   2. Symmetry
   3. Absolute Value Functions
   4. Composite Functions
3. 1.3 Exponential Functions (1 block)
   1. Exponential Growth
   2. Exponential Decay
   3. The number e
4. Extension: Transformations (1 block)
5. Extension: Conics (1 block)
6. 1.5 Functions and Logarithms (1 block)
   1. One –to – one functions
   2. Inverses
   3. Logarithmic Functions
   4. Properties of Logarithms
7. 1.6 Trigonometric Functions (1 block)
   1. Radian Measure
   2. Graphs of Trigonometric Functions
   3. Transformations of Trigonometric Graphs
   4. Inverse Trigonometric Functions
8. REVIEW (1 block)
9. TEST Chapter 1 (1 block)

**Unit 2: Limits and Continuity (8 blocks)**

1. 2.1 Rates of Change and Limits (2 blocks)
   1. Average and instantaneous speed
   2. Definition of limit
   3. Properties of limits
   4. One-sided and two-sided limits
2. 2.2 Limits Involving Infinity (1 block)
   1. Finite Limits
   2. End Behavior Models
   3. Infinite Limits
3. 2.3 Continuity (1 block)
   1. Continuity of a point
   2. Continuous functions
   3. Composites
4. 2.4 Rates of Change and Tangent Lines (1 block)
   1. Average rates of change
   2. Tangent to a curve
   3. Slope of a curve
   4. Normal to a curve
   5. Speed revisited
5. Review (2 blocks)
6. TEST Chapter 2 (1 block)

**Unit 3: Derivatives (13 blocks)**

1. 3.1 Derivatives of a Function (1 block)
   1. Definition of derivatives
   2. Notation
   3. Graphing the Derivative from Data
   4. One-sided derivatives
2. 3.2 Differentiability (1 block)
   1. Differentiability implies local linearity
   2. Derivatives on a calculator
   3. Differentiability implies continuity
   4. Intermediate value theorem for derivatives
3. 3.3 Rules of Differentiation (2 blocks)
   1. Positive integer powers, multiples, sums, and differences
   2. Products and quotients
   3. Negative integer powers of x
   4. Second and higher order derivatives
4. 3.4 Velocity and Other Rates of Change (1 block)
   1. Instantaneous rates of change
   2. Motion along a line
   3. Sensitivity to change
   4. Derivatives in economics
5. 3.5 Derivatives of Trigonometric Functions (1 block)
   1. Derivative of the sine function
   2. Derivative of the cosine function
   3. Derivatives of other trigonometric functions
6. Review (2 blocks)
7. TEST over Sections 3.1-3.5 (1 block)
8. 3.6 Chain Rule (1 block)
   1. Chain rules
   2. Derivative of a composite function
   3. Slopes of parameterized curves
9. 3.7 Implicit Differentiation (1 block)
   1. Implicitly Defined Functions
   2. Lenses, Tangents, and Normal lines
   3. Derivatives of higher order
   4. Rational powers of differentiable functions
10. 3.8 Derivatives of Inverse Trigonometric Functions (1 block)
    1. Derivatives of inverse functions (1 block)
11. 3.9 Derivatives of Exponential and Logarithmic Functions (1 block)

**Unit 4: Applications of Derivatives (10 blocks)**

1. 4.1 Extreme Values of Functions (1 block)
   1. Relative Extrema
   2. Absolute Extrema
   3. Extreme Value Theorem
   4. Definition of a critical point
2. 4.2 Mean Value Theorem (1 block)
   1. Physical Interpretation
   2. Increasing and decreasing functions
3. 4.3 Connecting *f’* and *f”* with Graph of *f* (1½ blocks)
   1. First Derivative test for local extrema
   2. Concavity
   3. Points of inflection
   4. Second derivative test for local extrema
4. 4.4 Modeling and Optimization (½ block)
5. Review (2 blocks)
6. TEST over 3.6-4.4 (1 block)
7. 4.5 Linearization (1 block)
   1. Local linearization
   2. Differentials
8. 4.6 Related Rates (2 blocks)

**Unit 5: The Finite Integral (8 blocks)**

1. 5.1 Estimating with Finite Sums (½ block)
   1. Distance traveled
   2. RAM
2. 5.5 Trapezoidal Rule (½ block)

a. Trapezoidal Approximations

1. 5.2 Definite Integrals (1 block)
   1. Riemann Sums
   2. Definite Integral and Area
2. 5.3 Definite Integrals and Anti-derivatives (1 block)
   1. Properties of definite Integrals
   2. Average Value of function
   3. Mean value theorem for definite integrals
3. 5.4 Fundamental Theorem of Calculus (2 blocks)
4. Review (2 blocks)
5. TEST 4.5-5.5 (1 block)

**Unit 6: Differential Equations and Mathematical Modeling (7 blocks)**

1. 6.1 Slope Fields and Euler’s Method (1 block)
2. 6.2 Anti-differentiation by Substitution (2 blocks)
   1. Indefinite Integrals
   2. Substitution in Indefinite Integrals
3. 6.4 Exponential Growth and Decay (1 block)
   1. Law of exponential change
   2. Separable differential equations
4. Review (2 blocks)
5. TEST Chapter 6 (1 block)

**Unit 7: Applications of Definite Integrals (10 blocks)**

1. 7.1 Integrals as net Change (1 block)
   1. Calculating distance traveled
   2. Consumption over time
   3. Net change from data
2. 7.2 Areas in the Plane (1 block)
   1. Area between the curve
   2. Boundaries with changing functions
   3. Integrating with respect to y
3. 7.3 Volumes (4 blocks)
   1. Cross Section
   2. Volume as an integral
4. Review (3 blocks)
5. TEST Chapter 7 (1 block)

**Review/Test Preparation (time varies, 8 blocks)**

1. Multiple-choice practice (items from past exams and review questions from other books)
   1. Test taking Strategies
   2. Individual and group practice
2. Free- response practice (Released items from AP website)
   1. Rubrics are reviewed so students see the need to complete answers.
   2. Students collaborate to formulate team responses
   3. Individually written responses are crafted. Attention to full explanation is emphasized

**After the exam**

**Unit 8: Sequences, L’Hopital’s Rule, and Improper Integrals (1 block)**

1. 8.2 L’Hopitals Rule (1 block)