AP Calculus AB Syllabus

mryousefian.weebly.com

Goal

My main objective in teaching AP Calculus is to have students see and appreciate the beauty of calculus graphically, numerically, analytically, and written down. We will explore functions and graphs in greater depth than in their previous courses and will study limits, derivatives, and integrals to a level that will allow success on the AP Exam.

A Balanced Approach

In your mathematical education, we will emphasize, "GNAW". There are a variety of ways to approach and solve problems. The four branches of the problem-solving tree of mathematics are:

- Graphical analysis (where a graph is known, but not an equation)
- Numerical analysis (where data points are known, but not an equation)
- Analytic/algebraic analysis (traditional equation and variable manipulation)
- Written/verbal methods of representing problems (classic application problems as well as written justification of one's thinking in solving a problem

Course Outline (from AP Central for Calculus AB)

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.

Technology Requirement

We will use a Texas Instrument 84 Plus and TI-Inspire graphing calculators in class regularly along with a "SmartBoard". You will want to have a graphing calculator as well. I recommend the TI-84. We will use the calculator in a variety of ways as a tool to illustrate ideas and topics. Following are some examples of how the calculator will be used:

- Conduct discovery and exploration including both concepts and applications
- Graph functions within arbitrary windows.

- Use the TABLE feature to observe the value of a function closer and closer to a given value of x both from the left and right in order to understand limits.
- Approximate the derivative at a point and approximate the value of a definite integral using numerical methods.
- Check to see if a function is differentiable at a point by using local linearity.
- Analyze and interpret results.
- Justify and explain graphs and equations.

Outline of Topics, Timeline, and Assessment

Below is an outline of topics along with a tentative timeline. The course is offered on a traditional schedule. Both formative and summative assessments are given. Summative assessments will occur as tests at the end of each unit as well as quizzes intermittently during each unit. Semester finals are also given. Formative assessments will include higher level questions and practice problems

Unit 1: Limits and Continuity

A. Limits at a point
- Definition of a limit
- Determining limits numerically, graphically and analytically
- Theorems on limits of functions
- One-sided limits
- Two sided limits
- Special trigonometric limits
- Intermediate value theorem
- Functions that do not have a limit

B. Limits involving infinity
- Asymptotic behavior
- End behavior
- Visualizing limits
- Properties of limits

C. Continuity
- Continuous functions
  - Definition of continuity
  - Visualizing continuity
- Discontinuous functions
  - Removable discontinuity
  - Non-removable discontinuity

D. Rates of Change
- Average
- Instantaneous
- Experiment: average and instantaneous velocity. Students discover what the slope of the secant line and the slope of the curve at a point represent.

Unit 2: The Derivative

A. Definition of the derivative of a function
B. Differentiability
   - Local linearity
   - Numeric derivatives using the calculator
   - Differentiability and continuity
   - Theorems on the derivative
C. Derivative rules
D. Applications to velocity and acceleration
E. Derivatives of trigonometric functions
F. The Chain Rule
G. Implicit derivatives
H. Derivatives of higher order

Unit 3: Applications of the Derivative

A. Extreme values
   - Local (relative) extrema
   - Global (absolute) extrema
B. Using the derivative
   - Mean value theorem
   - Rolle's Theorem
   - Increasing and decreasing functions
C. Analysis of graphs using the first and second derivatives
   - Critical values
   - First derivative test for extrema
   - Concavity and points of inflection
   - Second derivative test for extrema
D. Optimization problems
E. Related rates
F. Visualizing motion using parametric equations and the calculator
G. Graphical antidifferentiation
   - Given a derivative of a function, sketch the original function
   - Given a function, sketch its derivative
   - Match graphs of f and f' and f'' and f
H. Derivatives and differentials

Unit 4: Integration

A. Antiderivatives and indefinite integration
B. Basic integration rules
C. Computation of Riemann sums using left, right and midpoint evaluation points. Use of these sums to calculate area
D. The Fundamental Theorem of Calculus Part I
E. The Fundamental Theorem of Calculus Part 2
F. Evaluating definite integrals

G. Average Value of a Function
- Compute analytically

H. Solving differential equations
- Growth and decay
- Slope fields
  Given a slope field sketch an approximate solution to a differential equation
  Produce a slope field for a differential equation

I. Approximating areas with the trapezoidal rule
J. Using the integral of a rate of change to give accumulated change.
K. Integration using u substitution
L. Antiderivatives with change of limits for definite integrals
M. Relationship between continuity and integrability

Unit 5: Logarithmic, exponential, and other transcendental functions

A. The Natural Logarithmic Function
- Develop this function from the second part of the fundamental theorem
- Logarithmic properties
- Definition of e
- Logarithmic differentiation
- The log rule for integration

B. Integrals of the six basic trigonometric functions
C. Exponential functions
D. Indeterminate forms and L'Hopital's Rule
E. Inverse trig functions
- Differentiation
- Integration

Unit 6: Differential Equations

A. Solving logistic differential equations and using them in modeling
B. Separable differential equations
C. First order differential Equations
D. Logistic differential equations

Unit 7: Applications of Integration

A. Area
- Area between two curves

B. Integration as an accumulation process
C. Volume
- Volumes of solids of revolution
  disk method
  shell method
- Volumes of solids with known cross sections

D. Arc Length and Surface area
E. Particle Motion

- Distance traveled by a particle along a line
- Using parametric equations and the graphing calculator to show this motion

~~Unit 8: Integration Techniques, and Improper Integrals~~

- ~~Review of basic integration rules~~
- ~~Integration by parts~~
- ~~Trigonometric integrals~~
- ~~Trigonometric Substitution~~
- ~~Integration by partial fractions~~
- ~~Solving logistic differential equations and using them in modeling~~
- ~~Discovery activity on improper integrals~~
- ~~Improper integrals and their convergence and divergence, including the use of L'Hôpital's Rule~~

~~Unit 9: Infinite Series~~

- ~~Lab on Sequences~~
- ~~Convergence and divergence of sequences~~
- ~~Definition of a series as a sequence of partial sums~~
- ~~Convergence of a series defined in terms of the limit of the sequence of partial sums of a series~~
- ~~Introduction to convergence and divergence of a series by using technology on two examples to gain an intuitive understanding of the meaning of convergence~~
- ~~Geometric series and applications~~
- ~~The *n*th-Term Test for Divergence~~
- ~~The Integral Test and its relationship to improper integrals and areas of rectangles~~
- ~~Use of the Integral Test to introduce the test for *p*-series~~
- ~~Comparisons of series~~
- ~~Alternating series and the Alternating Series Remainder~~
- ~~The Ratio and Root Tests~~
- ~~Taylor polynomials and approximations: introduction using the graphing calculator~~
- ~~Power series and radius and interval of convergence~~
- ~~Taylor and Maclaurin series for a given function~~
- ~~Maclaurin series for sin x, cos x, e^x,~~
- ~~Manipulation of series, including substitution, addition of series, multiplication of series by a constant and/or a variable, differentiation of series, integration of series, and forming a new series from a known series~~
- ~~Taylor's Theorem~~

~~Unit 10: Plane Curves, Parametric Equations, and Polar Curves~~

- ~~Plane curves and parametric equations~~
- ~~Parametric equations and calculus~~

- ~~Parametric equations and vectors: motion along a curve, position, velocity, acceleration, speed, distance traveled~~
- ~~Analysis of curves given in parametric and vector form~~
- ~~Polar coordinates and polar graphs~~
- ~~Analysis of curves given in polar form~~
- ~~Area of a region bounded by polar curves~~

Unit 11: Review/Test Preparation

A. Multiple-choice practice including items from past exams
   - Test taking strategies are emphasized
   - Individual and group practice are both used

B. Free-response practice including released items from the AP Central website
   - Rubrics are reviewed so students see the need for complete answers
   - Students collaborate to formulate team responses
   - Individually written responses are crafted with attention to full explanation

Unit 12: After the Exam…

A. Projects designed to incorporate this year's learning in applied ways

B. Other topics in Calculus
   - Epsilon Delta proofs
   - Hyperbolic Trigonometry

Textbook:

Larson, Hostetler, Edwards. *Calculus*. 11th Edition.
This textbook will be our primary resource. You will benefit from reading it. It contains a number of interesting explorations that we will conduct with the goal that you discover fundamental calculus concepts. I will also explain topics in a way that students have found helpful over the years. I encourage cooperative learning, and I believe our entire class benefits from us all working together to help one another construct understanding.

Supplementary Resources:

Stewart, James. Single Variable Calculus Concepts & Context with Vector Functions. Thomson Brooks/Cole Publishing Co., 2007.

Grading Scale:

90 – 100 – A
80 – 89 – B
70 – 79 – C
60 – 69 – D
Below 60 – F

~~Homework~~ Practice Problems
Homework from the textbook or Khan Academy will not be taken for a grade, but is **highly recommended**. Tests and Quizzes will be based upon the problems assigned as homework. Therefore, it is **your responsibility** to study and ask questions upon the **next day's** class meeting. I will **not** keep up with whom and who doesn't do homework. However, I will assign and grade homework worksheet assignments that I distribute. In fact, it is no longer called homework. They are Practice Problems!

Quizzes
Quizzes will be announced and unannounced throughout the year. Quizzes will also be given as take-home and in-class assessments. I might drop the lowest quiz grade each semester. **I expect you to study and know the content.**

Tests
All tests will be announced. You will be allowed to use the calculator on some problems, **but work is required**. Students must know how to solve problems algebraically, numerically, and graphically.

Makeup Assessments
In general, students are expected to complete all assessments (i.e., tests, quizzes) on time. I recognize, however, that a variety of extenuating circumstances sometimes interfere with this, and I am committed to being flexible in working with students, within the bounds of fairness to all.

1. Excused Absence on day of assessment: If a student is absent on the day of an assessment, the assessment is to be made up on the day that the student returns to school, as arranged with the instructor.

2. Excused Absence prior to assessment: If a student is absent for one or more days immediately prior to an assessment, s/he *may* be allowed to delay the assessment by the number of excused days, at the discretion of the instructor. All formal assessments will be announced with advance notice of at least three days, and in general, an absence on the review day prior to a test does not exempt a student from his/her responsibility to prepare for the assessment. Any and all arrangements to delay an assessment ***must* be made with the instructor before** the class is scheduled to meet that day, preferably before school.

3. Absence during assessment period: If a student is absent from class but present in school on an assessment day (i.e., due to early dismissal for a sporting event or an outside appointment), **the assessment *must* be completed *that* day or the following school day**. It is the student's responsibility to make appropriate arrangements with the instructor. **Failure to complete the assessment will result in academic consequences, and may result in the student scoring a zero on the assessment, at the discretion of the instructor.**

NOTE: All unexcused absences will result in a zero.

Other circumstances: I realize that other extenuating circumstances (i.e., family emergencies, unusually heavy workloads in other classes, etc.) may make it difficult for a student to complete an assessment on the day that it is scheduled. I will attempt to work with students when this occurs, provided that arrangements are made in advance, before school begins that day. Plan ahead! I will be more likely to respond favorably to requests that are made in advance.

Expectations:

- ✓ You are expected to be ON TIME TO CLASS. This means you should be ready to begin class as soon as the bell rings. You must have a written note from a teacher to excuse ANY tardy.
- ✓ There is to be NO FOOD OR DRINK in the room at any time, unless told otherwise by the teacher.
- ✓ Class ends when I dismiss you. You are not to congregate next to the door waiting for the bell to ring.
- ✓ All students will be expected to have all homework completed on time.
- ✓ If you miss class for any reason, you are expected to pick up assignments upon the NEXT DAYS return.
- ✓ YOU are ACCOUNTABLE for your own performance in this class. Take OWNERSHIP.

DO NOT WAIT UNTIL THE MORNING THAT AN ASSIGNMENT IS DUE TO COME IN FOR HELP! DO NOT WAIT to start your homework the morning it is due. Begin working on an assignment the day it is announced so that you can ask questions in class the next day, or see me for help outside of class. I will not take homework questions during class on the day that it is due if you have had more than one day to work on it. By that time, you have had several opportunities to ask questions, and procrastination will not be tolerated. If you have any problems or concerns, TALK TO ME!

Website – mryousefian.weebly.com

Classroom Expectations

Be Respectful

- To each other: by not talking when teacher, guest speaker, or others are talking
- To the school: by treating school materials properly and upholding ***all*** school rules (i.e. proper use of electronics, ETC.)
- By cleaning up after yourselves

Be Responsible:

- Come to class on time and prepared with *all* necessary materials
- Turn in *all* work complete and on time
- Follow the given directions and stay on task
- Do your own work and be a good team member

How to Succeed in this Class:

1. Be seated and ready to go.
2. Take notes.
3. Ask questions.
4. Do your work.
5. Come in for additional help, i.e. tutoring.
6. Take part in class discussions.
7. Study!!!
8. BE RESPECTFUL!!!

If acquiring any of the materials is a problem, please contact me. Thank you for your time. Please feel free to contact me any time. I will be happy to answer any questions or concerns.

We hope that you want to learn as much as you can about calculus. Mathematicians have been responsible for many great developments throughout history. Much of our understanding of the universe is a direct result of the contributions of mathematicians. Who knows, perhaps we'll discover something during our course of studies. Whatever happens, I hope you learn to view math as more than just numbers, variables, processes, and algorithms. I hope you learn to apply your mathematical understanding to help you create a better understanding of the mathematical nature of our lives.

Sincerely,
Mr. Yousefian

Student Signature: _____Date:_____

Parent/Guardian Signature: _____Date:_____

Parent/Guardian Phone Number: _____

Parent/Guardian Email Address: _____