Sterling Heights High School AP Calculus AB Course Syllabus

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Section I: Overview of Advanced Placement Calculus AB

1. Course sequence leading to AP Calculus AB

   Geometry Acc

   Algebra II / Trig Acc

   Pre-Calculus

2. Student selection and prerequisites

   Students must demonstrate strong retention of prior material, exhibit strong analytical skills, solid graphing calculator skills, and a genuine enjoyment of mathematics.

3. Course description

   This full year course meets 60 minutes a day and covers all material as prescribed in the College Board course description. A College Board approved graphing calculator is required for the course and will be used regularly as a tool for discovery and for confirmation of analytic work. The course material is equivalent to a four credit college Calculus course including the branches of single variable differential and integral calculus. A multi-representational approach is used throughout the course. Students are expected to take the advanced placement test administered in May.

Section II: Course Materials

Larson, Hostetler, Edwards. *Calculus of a Single Variable.* Houghton Mifflin, 2006.

Various supplemental materials including but not limited to online resources, AP provided supplements and teacher derived exercises and illustrations.

College Board approved graphing calculator

Section III: Course Objectives

Unit 1: Limits and Continuity

1. Interpret the rate of change at an instant in terms of average rates of change over intervals containing that instant.
2. Represent limits analytically using correct notation.
3. Interpret limits expressed in analytic notation.
4. Estimate limits of functions.
5. Determine the limits of functions using limit theorems.
6. Determine the limits of functions using equivalent expressions for the function or the squeeze theorem.
7. Justify conclusions about continuity at a point using the definition.
8. Determine intervals over which a function is continuous.
9. Determine values of *x* or solve for parameters that make discontinuous functions continuous, if possible.
10. Interpret the behavior of functions using limits involving infinity.
11. Explain the behavior of a function over an interval using the Intermediate Value Theorem.

Unit 2: Differentiation: Definition and Fundamental Properties

1. Determine average rates of change using difference quotients.
2. Represent the derivative of a function as the limit of a difference quotient.
3. Determine the equation of a line tangent to a curve at a given point.
4. Estimate derivatives.
5. Explain the relationship between differentiability and continuity.
6. Calculate derivatives of familiar functions.
7. Interpret a limit as a definition of a derivative.
8. Calculate derivatives of products and quotients of differentiable functions.

Unit 3: Differentiation: Composite, Implicit, and Inverse Functions

1. Calculate derivatives of compositions of differentiable functions.
2. Calculate derivatives of implicitly defined functions.
3. Calculate derivatives of inverse and inverse trigonometric functions.
4. Determine higher order derivatives of a function.

Unit 4: Contextual Applications of Differentiation

1. Interpret the meaning of a derivative in context.
2. Calculate rates of change in applied contexts.
3. Interpret rates of change in applied contexts.
4. Calculate related rates in applied contexts.
5. Interpret related rates in applied contexts.
6. Approximate a value on a curve using the equation of a tangent line.
7. Determine limits of functions that result in indeterminate forms.

Unit 5: Analytical Applications of Differentiation

1. Justify conclusions about functions by applying the Mean Value Theorem over an interval.
2. Justify conclusions about functions by applying the Extreme Value Theorem.
3. Justify conclusions about the behavior of a function based on the behavior of its derivatives.
4. Calculate minimum and maximum values in applied contexts or analysis of functions.
5. Interpret minimum and maximum values calculated in applied contexts.
6. Determine critical points of implicit relations.
7. Justify conclusions about the behavior of an implicitly defined function based on evidence from its derivatives.

Unit 6: Integration and Accumulation of Change

1. Interpret the meaning of areas associated with the graph of a rate of change in context.
2. Approximate a definite integral using geometric and numerical methods.
3. Interpret the limiting case of the Riemann sum as a definite integral.
4. Represent the limiting case of the Riemann sum as a definite integral.
5. Represent accumulation functions using definite integrals.
6. Calculate a definite integral using areas and properties of definite integrals.
7. Evaluate definite integrals analytically using the Fundamental Theorem of Calculus.
8. Determine antiderivatives of functions and indefinite integrals, using knowledge of derivatives.
9. For integrands requiring substitution or rearrangements into equivalent forms:
    a. Determine indefinite integrals.
    b. Evaluate definite integrals.

Unit 7: Differential Equations

1. Interpret verbal statements of problems as differential equations involving a derivative expression.
2. Verify solutions of differential equations.
3. Estimate solutions to differential equations.
4. Determine general solutions to differential equations.
5. Determine particular solutions to differential equations.
6. Interpret the meaning of a differential equation and its variables in context.
7. Determine general and particular solutions for problems involving differential equations in context.

Unit 8: Applications of Integration

1. Determine the average value of a function using definite integrals.
2. Determine values for positions and rates of change using definite integrals in problems involving rectilinear motion.
3. Interpret the meaning of a definite integral in accumulation problems.
4. Determine net change using definite integrals in applied contexts.
5. Calculate areas in the plane using the definite integral.
6. Calculate volumes of solids with known cross sections using definite integrals.
7. Calculate volumes of solids of revolution using definite integrals.

Section IV: Teaching Strategies

The course offers students the opportunity to learn calculus concepts in a variety of ways attempting to appeal to a variety of learning styles.

Students experience teacher led discussion and guided discovery. They often work together in small groups to verify and explain homework problems to each other. There is also an emphasis on accurate communication of calculus in both written and verbal forms.

Graphing technology is used frequently as a tool to visually and numerically introduce, explore and reinforce concepts. Students are encouraged to verify analytic results using the four designated functions of the calculator; graphing, solving, numerical differentiation and integration. When analytic results do not agree with graphical results, students are expected to help one another trouble shoot, and solve the difficulty prior to seeking teacher guidance.

Students are regularly given two part tests, non-calculator and calculator active. Besides traditional calculus problems, tests often include multiple choice questions and questions requiring written explanations in order to prepare the students for AP style questions.

AP exam review consists of working released AP exam problems, both free response and multiple choice questions. Students are expected to present their solutions to various problems to the class, and those presentations are critiqued and discussed. Students are given cumulative tests and quizzes using old AP exam questions, and also practice grade their own attempts at previous exam questions. They also grade student samples as provided at the College Board web site.

Section VI: Grading

Quarter grades will be calculated as follows:

Assessments: 90%

Homework: 10%

Total: 100%

Semester grades will be calculated as follows:

Quarter 1 grade: 40%

Quarter 2 grade: 40%

Exam: 20%

Total: 100%

Section VII: Community Expectations

- ❖ Be present and on time.
    - We will be on an extremely tight schedule this year.
- ❖ Be mentally present during our time together.
    - Without the proper focus, learning goals will not be achievable
- ❖ Be kind to one another.
    - A good lifelong habit to develop.
- ❖ Respect the learning of others.
    - Your time of not understanding may be just around the corner.
- ❖ Ask meaningful questions.
    - "I don't get it!" isn't even a question.
- ❖ Always practice being an adult.
    - In the immortal words of Outkast…"Age ain't nothin' but a number."
- ❖ Embrace success.
    - If you believe that you can, you're already half-way home.