AP Calculus AB Syllabus

Rationale For Advanced Placement Calculus AB

The Advanced Placement Calculus AB course emphasizes conceptual understanding. Explanation and verbal justification are deemed just as important as formal rigor. The course is taught through a multi-representational approach to calculus, with concepts, results, and problems being expressed in a variety of ways, inclucing: geometrically, analytically, verbally and numerically. The course provides students with learning experiences that enable them to develop the computational skills and the knowledge and understanding of mathematical concepts that:

i) are needed in a technological age. Technology is regularly used by students and teacher to reinforce the relationships among the multiple representations of functions, to confirm written work, to implement experimentation, and to assist interpreting results.

ii) serve as a foundation for further study of mathematics. It is expected that students who take an AP course in calculus will seek college credit, or placement, or both, from institutes of higher learning.

iii) nurtures their appreciation of humanity's struggles in producing mathematical knowledge.

Course Overview

The course consists of one full year of rigorous work in calculus and related topics comparable to courses in colleges and universities. There are three goals:

1) All students gain a basic understanding of the concepts of limit, derivative, and integral.

2) Students are well prepared to take the Advanced Placement exam.

3) Students are prepared to move directly into a second semester college course in calculus.

To help accomplish these goals, we use the textbook *Calculus – Graphical, Numerical, Algebraic fifth edition* by Finney, Demana, Waits, Kennedy and Bressoud. The text is supplemented with a variety of worksheets and activities that reinforce concepts. Old AP exam questions are also used to develop student understanding and communication. (CR 4)

To further facilitate student's understanding of concepts, we will use a variety of technologies. Technology implementation includes extensive use of graphing calculators and associated programs, The Geometer's Sketchpad graphing software and Desmos to study limits, derivatives and integrals, and an occasional Youtube video. All students will have access to the TI-84 silver edition graphing calculator. Most students will have their own TI-84 and we will also have a classroom set. (CR 3a)

Course Planner

Unit 1 – Review

Text	Topics	Timeline
1.1	Lines	1 day
1.2	Functions and Graphs	1 day
1.3	Exponential Functions	1 day
1.5	Inverse Functions and Logarithms	2 days
1.6	Trigonometric Functions	1 day

Unit 2 – Limits and Continuity (Curricular Requirement 1a)

Text	Topics	Timeline
2.1	Limits – graphical, numerical, analytical	3 days
2.2	Limits @ infinity and infinite limits	2 days
2.3	Continuity	2 days
2.4	Rate of change and tangent lines	4 days
Page 97	Review Exercises	2 days

Unit 3 – Derivatives (CR 1b)

Text	Topics	Timeline
3.1	The Derivative (definition)	6 days
3.2	Differentiability	2 days
3.3	Rules for Differentiation	4 days
3.4	Velocity and Other Rates of Change	3 days
3.5	Derivatives of Trigonometry Functions	1 day
Page 150	Review Exercises	1 day

Unit 4 – Derivatives (CR 1b)

Text	Topics	Timeline
4.1	Chain Rule	4 days
4.2	Implicit Differentiation	2 days
4.3	Inverse Trig. Derivative	2 days
4.4	Derivs of Exponential and Log Functions	3 days
Page 188	Review Exercises	2 days

Unit 5 – Applications of Derivatives (CR 1b)

Text	Topics	Timeline
5.1	Extreme Values of Functions	2 days
5.2	Mean Value Theorem for Derivatives	4 days
5.3	Connecting f, f', & f''	3 days
5.4	Modeling and Optimization	2 days
5.5	Differentials	1 day
5.6	Related Rates	2 days
Page 242	Review Exercises	3 days

Unit 6 – The Definite Integral (CR 1c)

Text	Topics	Timeline
6.1	Estimating With Finite Sums	2 days
6.2	Definite Integrals	1 day
6.3	Definite Integrals and Antiderivatives	2 day
6.4	Fundamental Theorem of Calculus, Part I :Antiderivative part and Part II: Evaluation part	7 days
6.5	Trapezoidal Rule/Sums	3 days
Page 324	Review Exercises	1 day

Unit 7 – Differential Equations and Mathematical Models

Text	Topics	Timeline
7.1	Initial Value Problems and Slope Fields	3 days
7.2	Integration by Substitution	5 days
7.4	Exponential Growth and Decay	2 days
Page 379	Review Exercises	1 day

Unit 8 – Applications of Definite Integrals

Text	Topics	Timeline
8.1	Integral as Net Change	2 days
8.2	Areas of Plane Regions	2 days
8.3	Volume – Method of Disks and Washers	3 days
Page 458	Review Exercises	1 day
9.2	L'Hopital's Rule	1 day

Sample Activities that will be used to cover Curricular Requirements:

1. (CR 3b and 3c) Students will use the graphing calculator in a variety of ways (including exploration, solving and interpreting results). For example, as an introductions to limits, they will graph the function y = (sin x) / x. They will explore what happens to the graph as x approaches 0. This will be done in class so class discussion can take place. In class, they will learn to use the trace and table features of the calculator (for example: see what happens to the function y = 1/x when x approaches infinity and/or negative infinity). They will then use this knowledge on certain homework assignments where they are asked to find limits graphically. As part of a book assignment they will be asked to explore the limit graphically and then confirm it algebraically.

2. (CR 2a) Students will have many opportunities to reason with definitions and theorems throughout the course. One such example is in the homework assignment for section 5.2. Students are given a function and they must state whether or not the function satisfies the hypotheses of the Mean Value Theorem on a given interval. If it does, they will then find the value(s) where the instantaneous rate of change equals the mean rate of change.

3. (CR 2b) Throughout the course students will be given opportunities to connect concepts and processes. One such example is on the homework assignment in section 5.3. Students are given a set of information (for example: f(-2)=8, f'(x) > 0 for |x| > 2, f''(x) < 0 for x < 0 ……) and they must use that information to sketch the curve y = f(x). They are connecting f, f' and f''. Another example is the homework assignment for section 5.4 where students must solve problems involving optimization.

4. (CR 2c) Students will implement algebraic/computational processes throughout the course. One such example is in sections 6.1 where students are given a table of values of a function f and are asked to compute the right-hand and left-hand Riemann sums.

5. (CR 2d) Students are given opportunities to engage with graphical, numerical analytical and verbal representations and demonstrate connections among them. One such example is in the homework for section 6.1. Students are given a formula for a function. They are then asked to graph the function and estimate the area of a region bounded by the function, the x-axis, x = 2, and x = 24. They must then use that information to make a real-life estimation. Another example is question 51 in the homework assignment for section 3.3 (page 127 in the

approved textbook) where students are given a word problem regarding an apple farmer. Students are given no formulas, graphs, or mathematical symbols. They must read the paragraph provided and come up with the mathematical process for finding the instantaneous rate of increase using appropriate units of measure.

6. (CR 2e)

Students will be building notational fluency throughout the course. For example, on the assignment for section 6.2, students are given the limit of a Riemann Sum and they are asked to express it as a definite integral. Correct mathematical notation is the expectation in order to receive full credit on test questions.

7. (CR2f) Throughout the course, students will be working in small groups to share mathematical ideas and they will be writing mathematically in each chapter. Our textbook provides "Explorations" in every chapter where students (either in small groups or as a large class discussion) must share mathematical ideas orally. One such example is exploration 1 in section 2.2 where students explore functions and communicate orally to determine if/when the properties of limits can be applied. This exploration will be used as an in class activity. Students will communicate orally in small groups to determine if and why the limit of the function exists and whether the quotient rule can be applied. This activity will be followed by a whole class oral discussion. If possible, they will find the limit, meeting learning objective 1.1C. Another example is exploration 1 in section 3.5 where students explore a series of questions that leads them to discover the derivatives of the sine and cosine functions (learning objective 2.1C).

In addition, each chapter contains "Writing to Learn" questions, which will be used in daily assignments. For example, a question on the homework assignment in section 3.4: Writing to Learn: Suppose you are looking at a graph of velocity as a function of time. Explain, by writing complete sentences, how you can estimate the acceleration at a given point in time. (learning objective 2.3A,C)