**Course Outline Calculus**

## I. General Information

a. Calculus

b. Prerequisites: Completion of Pre-calculus with a grade of "C" or better.

c. Grade Level: 12

d. Length 1 year

e. Credit: 5 credits per semester

f. Course Summary: This course is a college level introductory calculus course designed to enable the student to pass the Advanced Placement exam in mathematics (Calculus A.B. exam)_ in order to receive college credit. Students must take the AHSME exam. Also, students should plan to take the A.P. exam. Students who choose not to do so will be required to take an alternate three hour exam.

## II. Course Content

There are no California Content Standards for this course.

**Topic outline**:

***1. Functions, Graphs, and Limits***

Analysis of graphs. With the aid of technology, graphs of functions are often easy to produce. The emphasis is on the interplay between the geometric and analytic information and on the use of calculus both to predict and to explain the observed local and global behavior of a function.

***Limits of functions (including one-sided limits).***

- An intuitive understanding of the limiting process.
- Calculating limits using algebra.
- Estimating limits from graphs or tables of data.

***Asymptotic and unbounded behavior.***

- Understanding asymptotes in terms of graphical behavior.
- Describing asymptotic behavior in terms of limits involving infinity.
- Comparing relative magnitudes of functions and their rates of change.

***Continuity as a property of functions.***

- An intuitive understanding of continuity
- Understanding continuity in terms of limits.
- Geometric understanding of graphs of continuous functions (Intermediate Value Theorem and Extreme Value Theorem).

***2. Derivatives***

***Concept of the derivative.***

- Derivative presented graphically, numerically, and analytically.
- Derivative interpreted as an instantaneous rate of change.
- Derivative defined as the limit of the difference quotient.
- Relationship between differentiability and continuity.

***Derivative at a point.***

- Slope of a curve ant a point.
- Tangent line to a curve at a point and local linear approximation.
- Instantaneous rate of change as the limit of average rate of change.
- Approximate rate of change from graphs and tables of values.

***Derivative as a function***

- Corresponding characteristics of graphs of *f and f'*.
- Relationship between the increasing and decreasing behavior of *f* and the sign of *f'*.
- The MeanValue Theorem and its geometric consequences.
- Equations involving derivatives. Verbal descriptions are translated into equations involving derivatives and vice versa.

***Second derivatives***

- Corresponding characteristics of the graphs of *f, f', and f''*.
- Relationship between the concavity of *f* and the sign of *f''*.
- Points of inflection as places where concavity changes.

***Applications of derivatives***

- Analysis of curves, including the notions of monotonicity and concavity.
- Optimization, both absolute (global) and relative (local) extrema.
- Modeling rates of change, including related rates problems.
- Use of implicit differentiation to find the derivative of an inverse function.
- Interpretation of the derivative as a rate of change in varied applied contexts, including velocity, speed, and acceleration.

***Computation of derivatives.***

- Knowledge of derivatives of basic functions, including power, exponential, logarithmic, trigonometric, and inverse trigonometric functions.
- Basic rules for the derivative of sums, products, and quotients of functions.
- Chain rule and implicit differentiation.

***3. Integrals***

***Interpretations and properties of definite integrals.***

- Computation of Riemann sums using left, right, and midpoint evaluation points.
- Definite integral as a limit of Riemann sums over equal subdivisions.
- Definite integral of the rate of change of a quantity over an interval interpreted as the change of the quantity over the interval:
- Basic properties of definite integrals. (Examples include additivity and linearity.)

***Applications of integrals.*** Appropriate integrals are used in a variety of applications to model physical, biological, or economic situations. Although only a sampling of applications can be included in any specific course, students should be able to adapt their knowledge and techniques to solve other similar application problems. Whatever applications are chosen, the emphasis is on using the integral of a rate of change to give accumulated change or using the method of setting up an approximating Riemann sum and representing its limit as a definite integral. To provide a common foundation, specific applications should include finding the area of a region, the volume of a solid with know cross sections, the average value of a function, and the distance traveled by a particle along a line.

***Fundamental Theorem of Calculus.***

- Use of the fundament Theorem to evaluate definite integrals.
- Use of the Fundamental theorem to represent a particular antiderivative, and the analytical and graphical analysis of functions so defined.

***Techniques of antidifferentiation.***

- Antidervatives following directly from derivatives of basic functions.
- Antiderivatives by substitution of variables (including change of limits for definite integrals).

***Applications of antidefferentiation.***

- Finding specific antiderivatives using initial conditions, including applications to motion along a line
- Solving separable differential equations and using them in modeling. In particular, studying the equation $y'=ky$ and exponential growth.

Numerical approximations to definite integrals.

Use of Riemann and trapezoidal sums to approximate definite integrals of functions represented algebraically, graphically, and by tables of value.

Change to Course Description for Calculus AB-Effective for the 2004 Examinations: Slope Fields

The following will be included in the topic outline for Calculus AB for the 2003-2004 academic year for the 2004 AP Examinations.

> "Geometric interpretation of differential equations via slope fields and the relationship between slope fields and solution curves for differential equations."(Applications of derivatives)

This topic has been part of the topic outline for Calculus BC since the 1998 AP

Examinations.

***III. INSTRUCTIONAL PLAN***

## *Semester 1*

***Chapter P: Preparation for Calculus***

P.1 Graphs and Models

P.2 Linear Models and Rates of Change

P.3 Functions and Their Graphs

P.4 Fitting Models to Data

***Chapter 1: Limits and Their Properties***

1.1 A Preview of Calculus

1.2 Finding Limits Graphically and Numerically

1.3 Evaluating Limits Analytically

1.4 Continuity and One-Sided limits

1.5 Infinite Limits

***Chapter 2: Differentiation***

2.1 The Derivative and the Tangent Line Problem

2.2 Basic Differentiation Rules and Rates of Change

2.3 The Product and Quotient Rules and Higher-Order Derivatives

2.4 The Chain Rule

2.5 Implicit Differentiation

2.6 Related Rates

***Chapter 3: Applications of Differentiation***

3.1 Extrema on an Interval

3.2 Rolle’s Theorem and the Mean Value Theorem

3.3 Increasing and Decreasing Functions and the First Derivative Test

3.4 Concavity and the Second Derivative Test

3.5 Limits at Infinity

3.6 A Summary of Curve Sketching

3.7 Optimization Problems

3.8 Newton’s Method

3.9 Differentials

3.10 Business and Economics Applications

***Chapter 4: Integration***

4.1 Antiderivatives and Indefinite Integration

4.2 Area

4.3 Riemann Sums and Definite Integrals

4.4 The Fundamental Theorem of Calculus

4.5 Integration by Substitution

4.6 Numerical Integration

## *Semester 2*

***Chapter 5: Logarithmic, Exponential, land Other Transcendental functions***

5.1 The Natural Logarithmic Function and Differentiation

5.2 The Natural Logarithmic Function and Integration

5.3 Inverse Functions

5.4 Exponential functions: Differentiation and Integration

5.5 Bases other than ***e*** and Applications

5.6 Differential Equations: Growth and Decay

5.7 Differential Equations: Separation of Variables

5.8 Inverse trigonometric functions and differentiation

5.9 Inverse trigonometric functions and Integration

***Chapter 6: Applications of Integration***

6.1 Area of a Region between Two Curves

6.2 Volume: The Disc Method

6.3 Volume: The Shell Method

***Chapter 7: Integration Techniques, L'Hopital's Rule, and Improper Integrals***

7.1 Basic Integration Rules

7.2 Integration by Parts

7.3 Trigonometric Integrals

7.4 Trigonometric Substitution

7.6 Integration by Tables and Other Integration Techniques

7.7 Indeterminate Forms and L'Hopital's Rule

***IV. Assessment***:

Students will earn a letter grade (A+ through F) based on their achievement in the course. Each graded assignment, test, quiz, etc. is important. Progress reports will be given occasionally to help monitor student progress. Grades are entered into my grading program as a letter grade and assigned a computer code value as follows. A+ 100, A 95, A- 90, B+ 85, … D 50, D- 45, F + 40, F 1, absent 0. The program will then calculate a course grade using the weighted percentages for each category listed below and print the letter grade earned for that student.

The student's final grade is broken down in the following way: FINAL: 25% (Department Requirement)

CHAP and MID TERM EXAMS 45% (Count 70% until Final).

HOMEWORK: 15%

HANDOUT/CLASSWORK: 10%

OTHER: 5%

[I reserve the right to change these percentages if more is accomplished than expected in any one area.] Missed Exams: Students will take the missed exam the day they return or the exam will be replaced with the student's midterm (during Q1, Q3) or semester final (during Q2, Q4). Exams are not returned to students to keep. Missed quizzes or other class activities will be replaced with the current chapter exam.

***V. Text***

**Houghton Mifflin Company: Calculus** sixth Edition by Larson, Hostetler, and Edwards