Murrieta Valley Unified School District
High School Course Outline
April 2013

Department: Math

Course Title: Advanced Placement Calculus AB

Course Number: 2400

Grade Level: 11-12 elective

Length of course: Two semesters

Prerequisite: Math Analysis and Trigonometry with a B or better; or Precalculus with an A

I. Goals - 1st Semester

The student will:

A. Demonstrate knowledge of the real number system by
   1. Identifying subsets of real numbers
   2. Determining order relationships on the real number line
   3. Defining sets of real numbers using interval and set notation
   4. Solving rational inequalities
   5. Writing the definition and using the properties of absolute value
   6. Solving absolute value equations and inequalities

B. Demonstrate knowledge of functions, their graphs and other curves by
   1. Finding the slope of a line given its graph or equation
   2. Writing the equation of a line in slope-intercept or point-slope form
   3. Writing the definition of a function
   4. Identifying the domain and range of a function given its graph or equation
   5. Graphing and translating functions with and without calculators
   6. Forming new functions by performing arithmetic operations and/or function composition on two or more original functions
   7. Finding the inverse of a function
   8. Determining the symmetry of a function
   9. Expressing functions in parametric form
   10. Graphing parametric equations with and without a calculator

C. Demonstrate the ability to use limits to predict and explain the local and global behavior of functions by
   1. Writing the definition of a limit
   2. Calculating limits
   3. Estimating limits from a graph or table

4. Describing asymptotic behavior in terms of limits
5. Writing and applying the definition of continuity at a point and on an interval
6. Recognizing the implications of continuity as it pertains to the Intermediate Value Theorem and Extreme Value Theorem

D. Demonstrate understanding of the concept of the derivative by
1. Finding a derivative by calculating the limit of a difference quotient
2. Interpreting the derivative as an instantaneous rate of change
3. Explaining the relationship between differentiability and continuity
4. Demonstrating the relationship between the graph of a function and that of its derivative
5. Finding the instantaneous rate of change by calculating the limit of average rate of change

E. Demonstrate the ability to apply the geometric interpretation of the derivative by
1. Finding the slope of a line tangent to the graph of function at a point
2. Explaining the relationship between the derivative at a point and the slope of a secant line through that point
3. Writing and explaining the Mean Value Theorem and its geometric consequences
4. Determining where a function is increasing or decreasing based on the value of its derivative
5. Determining concavity and points of inflection of a function using the first and second derivatives of the function

F. Demonstrate the ability to find the derivative of a function by
1. Computing the derivatives of sums, products and quotients of functions
2. Applying the formulas for derivatives of basic functions including polynomial, exponential, logarithmic, trigonometric and inverse trigonometric functions
3. Using the chain rule
4. Performing implicit differentiation

G. Demonstrate the ability to apply the derivative of a function by
1. Drawing the graph of a function based on information about its first and second derivatives
2. Finding absolute and relative extrema
3. Solving optimization problems
4. Solving related rate problems
5. Finding limits of indeterminate functions
6. Using implicit differentiation to find the derivative of an inverse function
7. Finding the equations of tangent and normal lines at a point on a curve

8. Finding the local linear approximation using differentials and derivatives
9. Using derivatives to relate displacement, speed, velocity and acceleration

H. Demonstrate understanding of the concept of integration by
1. Evaluating indefinite integrals of basic algebraic, trigonometric, logarithmic, exponential and inverse trigonometric functions
2. Evaluating indefinite integrals by substitution
3. Using indefinite integrals to find slope/direction fields and solve basic differential equations and initial value problems
4. Using the Fundamental Theorem of Calculus to evaluate a definite integral
5. Using substitution and limit conversion to evaluate a definite integral

I. Demonstrate understanding of the relationship between area and the definite integral by
1. Approximating the area under a curve by Riemann sums using left, right, and midpoint evaluation points
2. Finding the exact area under a curve by finding the limit of the Riemann sum
3. Defining the definite integral as the limit of a Riemann sum over both equal and unequal subintervals
4. Applying the linear and additive properties of definite integrals
5. Deriving and applying the Mean-Value Theorem for Integrals
6. Interpreting the definite integral of the rate of change of a quantity over an interval as the change in the quantity over the interval

J. Demonstrate the ability to apply integration by
1. Finding the area under a curve
2. Finding the area enclosed by two curves
3. Finding the volume of a solid of revolution using disks and washers
4. Finding the volume of a solid of revolution using cylindrical shells
5. Finding the length of a plane curve
6. Finding the area of a surface of revolution
7. Finding the distance traveled by a particle moving along a line
8. Finding the average value of a function over an interval
9. Finding the work done by a variable force
10. Finding the fluid force exerted on a submerged surface

II. Outline of Content for Major Areas of Study

Semester I

A. The real number system
1. Subsets of real numbers
2. The real number line and order relationships

3. Interval and set notation
4. Rational inequalities and absolute value equations and inequalities
5. Properties of absolute value

B. Functions, their graphs and other curves
1. Slope as a rate of change and equations of lines
2. Definition of a function and domain and range
3. Combinations, compositions and inverses of functions
4. Symmetry of functions
5. Parametric equations

C. Limits and continuity
1. Definition of a limit
2. Estimating and calculating limits
3. Definition of continuity

D. The concept of the derivative
1. Definition of a derivative and the limit of a difference quotient Interpretations of a derivative
2. Differentiability and continuity
3. The relationship between the graph of a function and its derivative
4. Instantaneous rate of change as a limit of average rate of change

E. Geometric aspects of the derivative
1. Derivatives as the slope of the tangent line
2. Tangent lines as the limit of secant lines
3. Mean Value Theorem
4. Intervals of increase/decrease, concavity and points of inflection

F. Finding the derivatives of functions
1. Derivatives of sums, products and quotients
2. Formulas for derivatives of polynomial, exponential, logarithmic, trigonometric and inverse trigonometric functions
3. The chain rule and implicit differentiation.

G. Applications of the derivative
1. Using derivatives to draw the graph of a function
2. Absolute and relative extrema
3. Optimization using derivatives
4. Related rates
5. Limits of indeterminate functions
6. Implicit differentiation and derivatives of inverse functions
7. Local linear approximation
8. Equations of tangent and normal lines
9. Displacement, speed, velocity and acceleration

Semester II

A. The concept of integration

1. Indefinite integrals of basic algebraic, trigonometric, logarithmic, exponential and inverse trigonometric functions
2. Evaluating integrals by substitution
3. Slope/direction fields
4. The Fundamental Theorem of Calculus
5. Substitution and limit conversion to evaluate definite integrals

B. Area and the definite integral
1. Riemann sum approximations of area
2. Limits of Riemann sums to find exact area
3. The definition of the definite integral as the limit of a Riemann sum
4. Properties of definite integrals
5. The Mean-Value Theorem for Integrals

C. Applications of integration
1. Area under a curve
2. Area enclosed by two curves
3. Volumes of solids of revolution
4. Length of a plane curve
5. Area of a surface of revolution
6. Distance traveled by a particle moving along a line
7. The average value of a function over an interval
8. Work done by a variable force
9. Fluid force exerted on a submerged surface

III. Accountability Determinants

A. Quizzes and examinations of basic understanding and problem solving skill

B. Lab projects.

C. Homework assignments

D. Oral presentations

IV. AP Exam Requirement

Students attempting to receive college credit for Advanced Placement and International Baccalaureate courses are required to pass a College Board exam which validates coursework. This exam **is not a requirement** for District High School credit, grade increases, or extra credit.

Student fees are allowable for Advanced Placement and International Baccalaureate Diploma examinations **for college credit**, so long as (1) taking the exam is not a course requirement; (2) the exam results have no impact on a pupil's grade or credit in a course; and (3) eligible economically disadvantaged high school pupils who receive school district funding towards the exam fee shall

pay $5.00 of the fee. (EC sections 52240-52244; 52920-52922.)

V. Required Text

Anton, Howard; Bivens, Irl; David, Stephen. *Calculus--Early Transcendentals, 7th Edition.* New York: John Wiley and Sons, 2002.

VI. Supplemental Materials

Finney, Ross L. *Calculus – Graphical, Numerical, Algebraic.* Needham, Massachusetts: Pearson/Prentice Hall, 2003.