Murrieta Valley Unified School District
High School Course Outline
April 2004

Department: Mathematics

Course Title: Calculus

Course Number: 2390

Grade Level: 11-12 elective

Length of course: Year

Prerequisite: Pre-calculus with a grade of B or better

UC/CSU (A-G) Requirement: C (Pending UC Approval)

I. Goals

The student will:

A. Demonstrate knowledge of both the formal definition and the graphical interpretation of the limit of a function by *(Calculus Standards 1.0,1.1, 1.2, 1.3, 2.0, & 3.0)*
   1. Finding one-sided and two-sided limits as the domain variable approaches a number
   2. Finding limits as the domain variable approaches infinity
   3. Determining limits from graphs, tables and using a graphing calculator
   4. Computing limits using the basic properties of limits as they pertain to sums, products, quotients, roots, and function compositions
   5. Finding limits of functions in indeterminate form
   6. Writing the definition of continuity at a point
   7. Determining the continuity of a function at a point and on an interval
   8. Determining whether or not a discontinuity is removable
   9. Finding the limits of trigonometric functions
   10. Determining the continuity of trigonometric functions
   11. Using the intermediate value theorem to find roots of functions

B. Demonstrate knowledge of the definition and interpretations of the derivative of a function by *(Calculus Standards 4.0, 4.1, 4.2, 4.3, 4.4, 5.0, 6.0, & 7.0)*
   1. Using the definition to calculate the derivative of basic functions
   2. Recognizing the relationship between differentiability and continuity
   3. Using the formulas and techniques of differentiation to find the derivatives of algebraic, trigonometric, inverse trigonometric, exponential and logarithmic functions

4. Finding the equation of a tangent line to the graph of a function using the derivative of the function
5. Finding the instantaneous rate of change of a function using the derivative
6. Using the chain rule to differentiate composite functions
7. Using implicit differentiation to find the derivative of functions not explicitly defined

C. Demonstrate understanding of the applicability of derivatives by *(Calculus Standards 8.0, 9.0, 10.0, 11.0, & 12.0)*
1. Finding intervals on which a function is increasing or decreasing
2. Finding the relative and absolute extrema of a function on an interval
3. Determining the concavity of a function and finding its points of inflection
4. Sketching the graph of a function using its derivative
5. Using Newton's method for approximating the zeros of functions
6. Solving applied optimization (maximum/minimum) problems
7. Solving related rate problems
8. Using L'Hopital's rule to find the limit of a function in indeterminate form

D. Demonstrate understanding of the concept of integration by *(Calculus Standards 13.0, 14.0, 15.0, 16.0, 17.0, 18.0, 19.0, 20.0, 21.0, & 22.0)*
1. Finding the antiderivative of a function
2. Evaluating integrals by substitution, integration by parts and trigonometric substitution
3. Expressing inverse trigonometric functions as indefinite integrals
4. Using the limit of a Riemann sum to find the area under a curve
5. Relating Riemann sums to definite integrals
6. Using the fundamental theorem of calculus to evaluate definite integrals
7. Using definite integrals to model problems and solve differential equations
8. Using definite integrals to solve problems involving area, velocity, acceleration, volume of a solid, the area of a surface of revolution, the length of a plane curve, work and fluid force
9. Using the techniques of partial fractions and completing the square to evaluate integrals of rational functions
10. Performing numerical integration using Simpson's rule and on a calculator
11. Evaluating improper integrals as the limits of definite integral

E. Demonstrate understanding of the concepts of convergence and divergence of sequences and series by *(Calculus Standards 23.0, 24.0, 25.0, 26.0, & 27.0)*
1. Determining convergence using the comparison test, ratio test and alternating series test
2. Computing the interval of convergence
3. Forming new series from old ones by differentiation and integration; including the power series
4. Calculating Taylor polynomials and Taylor series of basic functions, including the remainder term

5. Solving elementary differential equations including those involving growth and decay

II. Outline of Content for Major Areas of Study

Semester I

A. Functions, their graphs and other curves
   1. Definition of a function and domain and range
   2. Properties of functions
   3. Lines and families of functions
   4. Combinations, compositions and inverses of functions
   5. Mathematical models
   6. Parametric equations

B. Limits and continuity
   1. Definition of a limit
   2. Estimating and calculating limits
   3. Definition of continuity
   4. Limits and continuity of trigonometric functions

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

D. 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

E. 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
   4. Related rates
   5. Inverse functions
   6. Exponential and logarithmic functions and their derivatives
   7. Inverse trigonometric functions and their derivatives
   8. L'Hopital's rule

F. Applications of the derivative
   1. Intervals of increase, decrease and concavity

2. First and second derivative tests
3. Using derivatives to draw the graph of a function
4. Absolute and relative extrema
5. Optimization using derivatives
6. Limits of indeterminate functions
7. Implicit differentiation and derivatives of inverse functions
8. Local linear approximation
9. Equations of tangent and normal lines
10. Rectilinear motion – displacement, velocity and acceleration
11. Newton's method
12. Rolle's theorem and the mean value theorem

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. The fundamental theorem of calculus
   4. 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

D. Advanced integration techniques
   1. Integration by parts
   2. Trigonometric integrals and trigonometric substitution
   3. Integrating rational functions by partial fractions
   4. Numerical integration and Simpson's rule
   5. Improper integrals

E. Infinite series
   1. Convergence tests
   2. The comparison, ratio and root tests
   3. Alternating series and conditional convergence
   4. Power series
   5. Taylor series
   6. Differential equations

III. Accountability Determinants

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

B. Lab projects

C. Homework assignments

D. Oral presentations

IV. Required Text

Anton, Howard et al. *Calculus--Early Transcendentals, 7th Edition.* New York, New York: John Wiley & Sons, Inc., 2002.

V. Supplementary Materials

Graphing calculators