FOLSOM CORDOVA UNIFIED SCHOOL DISTRICT

HIGHLIGHTS OF CALCULUS

Date: January 2016
Proposed Grade Level(s): 11th-12th **Subject Area: Mathematics**
Grading: A-F **Course Length: One year**
Prerequisites: "C" or "B" in Pre-Calculus **Number of Credits: 5 per semester**

Intent to Pursue 'A-G' College Prep Status: Yes

COURSE DESCRIPTION:

Highlights of Calculus will cover some of the basic concepts of calculus while maintaining a continual emphasis on algebra and trigonometry. The standards are based on Common Core Standards for Mathematics and include concepts from the conceptual categories: Algebra, Functions, and Geometry. Instructional time will focus on four critical areas: (1) expand understanding of functions to include polynomial, rational, radical, trigonometric, exponential, and logarithmic; (2) a comprehensive, detailed review of concepts from Algebra One and Algebra Two; (3) a comprehensive, detailed review of trigonometric concepts; (4) application of algebraic and trigonometric skills to the solution of calculus-based problems involving derivatives and anti-derivatives.

GENERAL GOALS/PURPOSES:

The course is aimed at the student whose algebraic and trigonometric skills are fair but not strong. The focus of Highlights of Calculus is for students to reinforce those skills while learning basic concepts of calculus. Students will solve calculus-based problems dealing with real life situations.

CCSS STUDENT READING/WRITING/SPEAKING and LISTENTING COMPONENTS:

The curriculum has literacy strategies embedded within the text that assista students in the following:

- Understanding math tasks
- Communicating understanding orally and through writing
- Writing about math
- Building math vocabulary
- Building academic vocabulary

The eight *Standards for Mathematical Practice* describe the attributes of mathematically proficient students and expertise that mathematics educators at all levels should seek to develop in their students. Mathematical practices provide a vehicle through which students engage with and learn mathematics – with a heavy focus on reading, writing, and explaining.

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.

7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

DETAILED UNITS OF INSTRUCTION:

Chapters	Standards	Unit Overview
1: Linear Functions	F-LE	The first unit consists of a review of slope and the various forms of linear equations.
2: Composite Functions	F-BF F-LE Calc 1.1	Students will acquire expertise at identifying and working with the composition of functions.
3: Trigonometric Functions	F-TF G-SRT	This unit will review the basic trigonometric functions and identities.
4: Limits and their Properties	Calc 1.1 Calc 1.3	Students will explore the properties and characteristics of limits. They will find limits graphically, numerically, and analytically, focusing on using trigonometric properties and reinforcing algebraic skills.
5: Continuity	Calc 2.0	Students will use their manipulative algebraic skills to determine both one-sided limits and infinite limits.
6: Derivatives	Calc 4.1 Calc 4.3	Students use their factoring skills to find derivatives of polynomial and rational functions by learning the product, quotient, and power rules.
7: Chain Rule	Calc 5.0	Students will use their numerical and algebraic skills to use the chain rule to determine derivatives of composite functions.
8: Implicit Differentiation	Calc 6.0	By applying properties of algebra and calculus, students will find derivatives implicitly rather than explicitly.
9: Related Rates	N-Q Calc 12.0	Students will solve rate problems that relate to our world.
10: Simultaneous Linear Equations	A-REI	This unit consists of the solution of simultaneous linear equations by addition and by substitution.
11: Partial Fractions	A-APR	Students will manipulate rational algebraic expressions to determine the constants in the numerators of partial fractions. They will use this technique later on to find the anti-derivatives of rational functions.
12: Exponential Functions	A-SSE	Students will review exponential functions and their graphs, as studied in Pre-calculus. They will be able to graph exponential functions and determine the equation of a function when presented with its graph.
13: Derivatives of Exponential and Logarithmic Functions	Calc 4.4	Students will find derivatives of basic exponential and logarithmic functions without the use of standard formulas.
14: Inverse Trigonometric Functions	G-SRT	This unit will review the domain and range of inverse trigonometric functions.
15: Derivatives of Inverse Trigonometric	Calc 4.4	Students will learn how to find derivatives of inverse trigonometric functions without the use of formulas.

Functions		
16: Polynomial Operations	A-APR	This unit will review basic operations of polynomials, including synthetic division and finding zeros of polynomials. As a stepping stone to finding critical numbers, it will also include a comprehensive review of the solution of polynomial inequalities.
17: Extrema on an Interval	Calc 9.0	By factoring functions that represent derivatives, students will apply what they learned in the previous unit. The importance of determining critical numbers of a function will be emphasized.
18: Optimization	Calc 4.2	The unit involves the presentation and solution of practical (business, science) applications of extrema.
19. Parabolas and Linear Functions	F-BF	Students will undergo extensive practice graphing vertical and horizontal parabolas, and determining where the graphs intersect given lines.
20: Anti-derivatives	Calc 15.0	Students will learn the techniques of substitution and separation to determine the anti-derivative of basic functions.
21: Definite Integrals and Area	Calc 13.0	Students will combine their knowledge of parabolas (Unit 19) and linear functions with their ability to compute definite integrals to determine areas between curves.
22: Differential Equations	Calc 27.0	This is an introductory unit dealing with the solution of simple ordinary differential equations by the method of separation of variables. Students will translate real life problems into differential equations, which they will then solve.

TEXTBOOKS AND RESOURCE MATERIALS:

Calculus 1 with Precalculus, 3rd Edition, Larson
Pre-calculus, Larson/Hostetler, Sixth Edition, Houghton Mifflin Company
Calculus of a Single Variable, Seventh Edition, Houghton Mifflin Company

COMMON CORE STATE STANDARDS ADDRESSED:

The content standards addressed in this course come from each of the conceptual categories:

- Number and Quantity
- Algebra
- Functions
- Modeling
- Geometry
- Statistics and Probability

***See attachment for specific state standards addressed.**

DISTRICT ESLRs TO BE ADDRESSED:

When students exit a secondary mathematics course, they will be:

- **Self-directed Learners** who will be able to use notes and a textbook to assist them in continuing their learning outside of the classroom setting.

- **Efficient Communicators** who can explain mathematical concepts to others and use mathematics to organize and explain data.
- **Quality Producers** who understand the importance of neat, organized work that demonstrates their thinking and understanding of the solution they've formed to solve a problem.
- **Constructive Thinkers** who are able to attack problems with organization, logic, and mathematical skills they've developed in a systematic fashion.
- **Collaborative Workers** who can work in a variety of settings in culturally diverse groups. They will be able to form and use study groups to strengthen their own understanding in addition to providing the same service for classmates.
- **Responsible Citizens** who accept the consequences of their actions and who demonstrate their understanding of their role in the learning process.

ATTACHMENT 1:
Highlights of Calculus State Standards Addressed

- **Number and Quantity**
  - Quantities
    - Reason and quantitatively and use units to solve problems.
- **Algebra**
  - Reasoning with Equations and Inequalities
    - Understand solving equations as a process of reasoning and explain the reasoning.
    - Solve equations and inequalities in one variable.
    - Solve systems of equations
    - Represent and solve equations and inequalities graphically.
  - Arithmetic with Polynomials and Rational Expressions
    - Perform arithmetic operations on polynomials.
    - Understand the relationship between zeros and factors of polynomials.
    - Use polynomial identities to solve problems.
  - Seeing Structure in Expressions
    - Interpret the structure of expressions.
    - Write expressions in equivalent forms to solve problems.
- **Functions**
  - Building Functions
    - Build a function that models a relationship between two quantities.
    - Build new functions from existing functions.
  - Linear, Quadratic, and Exponential Models
    - Construct and compare linear, quadratic, and exponential models and solve problems.
    - Interpret expressions for functions in terms of the situation they model.
  - Trigonometric Functions
    - Extend the domain of trigonometric functions using the unit circle.
    - Model periodic phenomena with trigonometric functions.
    - Prove and apply trigonometric identities.
- **Geometry**
  - Similarity, Right Triangles, and Trigonometry
    - Understand similarity in terms of similarity transformations.
    - Prove theorems involving similarity.
    - Define trigonometric ratios and solve problems involving right triangles.
    - Apply trigonometry to general triangles.
- **Calculus**
  - 1.0 Students demonstrate knowledge of both the formal definition and the graphical interpretation of limit of values of functions. This knowledge includes one-sided limits, infinite limits, and limits at infinity. Students know the definition of convergence and divergence of a function as the domain variable approaches either a number or infinity:

        - 1.1 Students prove and use theorems evaluating the limits of sums, products, quotients, and composition of functions.
        - 1.3 Students prove and use special limits, such as the limits of $(\sin(x))/x$ and $(1-\cos(x))/x$ as x tends to 0.
    - 2.0 Students demonstrate knowledge of both the formal definition and graphical interpretation of the continuity of a function.
    - 4.0 Students demonstrate an understanding of the formal definition of the derivative of a function at a point and the notion of differentiability:
        - 4.1 Students demonstrate an understanding of the derivative of a function as the lsope of the tangent line to the graph of the function.
        - 4.2 Students demonstrate an understanding of the interpretation of the derivative as an instantaneous rate of change. Students can use derivatives to solve a variety of problems from physics, chemistry, economics, and so forth that involve the rate of change of a function.
        - 4.3 Students understand the relation between differentiability and continuity.
        - 4.4 Students derive derivative formulas and use them to find the derivatives of algebraic, trigonometric, inverse trigonometric, exponential, and logarithmic functions.
    - 5.0 Students know the chain rule and its proof and applications to the calculation of the derivative of a variety of composite functions.
    - 6.0 Students find the derivatives of parametrically defined functions and use implicit differentiation in a wide variety of problems in physics, chemistry, economics, and so forth.
    - 9.0 Students use differentiation to sketch, by hand, graphs of functions. They can identify maxima, minima, inflection points, and intervals in which the function is increasing and decreasing.
    - 12.0 Students use differentiation to solve related rate problems in a variety of pure and applied contexts.
    - 13.0 Students know the definition of the definite integral by using Riemann sums. They use this definition to approximate integrals.
    - 15.0 Students demonstrate knowledge and proof of the fundamental theorem of calculus and use it to interpret integrals as anti-derivatives.
    - 27.0 Students know the techniques of solution of selected elementary differential equations and their applications to a wide variety of situations, including growth-and-decay problems.