MT. DIABLO UNIFIED SCHOOL DISTRICT
COURSE OF STUDY

COURSE TITLE COURSE:	**Pre-Calculus Honors**
COURSE NUMBER:	**1405**
CALPADS NUMBER:	**2414**
~~**CST:**~~	~~**Summative Math**~~
DEPARTMENT:	**High School Mathematics**
~~**NCLB CREDENTIAL**~~	
REQUIREMENT:	**Math Credential with Subject Matter Proficiency**
LENGTH OF COURSE:	**One Year**
CREDITS PER SEMESTER:	**5**
GRADE LEVEL(S):	**10-12**
REQUIRED OR ELECTIVE:	**This course fulfills one year of the high school mathematics requirement and UC/CSU "c" requirement.**
PREREQUISITES:	**B or better in Algebra I/Trigonometry, Advanced Math Topics and/or Teacher recommendation.**

BOARD OF EDUCATION ADOPTION: ~~**June 22, 2010**~~

~~**COURSE DESCRIPTION:**~~

~~Pre-Calculus Honors is considered to be the third or fourth year of a very strong high mathematics program, but is also taught at the college level where it is the second college level course in mathematics after trigonometry. Pre-Calculus Honors refines the Trigonometric, Geometric and Algebraic techniques needed in the study of Calculus. New skills will be introduced and many old skills will be pushed to new heights with a conceptual understanding beyond the reach of most high school students.~~

COURSE OVERVIEW

Pre Calculus Honors combines many of the trigonometric, geometric and algebraic techniques needed to prepare students for the study of calculus and strengthens their conceptual understanding of problems and mathematical reasoning in solving problems.

Students will be introduced to matrices, vectors, polar graphing, parametric equations, conic sections, and introductory calculus topics. The approach to problem-solving in this course is done numerically, graphically, algebraically and verbally.

Students will build upon and further explore expressions, equations and functions learned in earlier math courses to develop patterns, make and test conjectures, and create multiple representations. Students will also learn about inverse functions and how restricting the domain of a function that is not always increasing or decreasing allows its inverse to be constructed. Students will apply their knowledge of trigonometry as they explore the unit circle and model trigonometric functions. Students will solve real-world problems involving the Laws of Sines and Cosines. Students are introduced to vectors in the complex plane and gain fluency transferring between rectangular and polar forms. Students will derive equations for conic sections from the definition of foci and by completing the square. Students build on their prior experience with sequences to explore series.

In addition to the California Common Core State Standards for Mathematics, students will experience and gain fluency with the 8 Standards for Mathematical Practice:

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

Overall, the quality of a learning environment depends on the extent to which it provides opportunities for students along the following five dimensions:

1. The richness of disciplinary concepts and practices (“the content”) available for learning;
2. Student sense-making and “productive struggle”;
3. Meaningful and equitable access to concepts and practices for all students;
4. Means for constructing positive disciplinary identities through presenting, discussion and refining ideas; and
5. The responsiveness of the environment to student thinking.

~~**COURSE OUTLINE:**~~

~~**1.MAJOR GOALS**~~

~~1.1 To acquire greater depth and understanding of functions~~

~~1.2 Apply various functions and mathematical processes to real world problems and careers.~~

~~1.3 To acquire foundational knowledge and skills for calculus and statistics. 1.4 Utilize technology to enhance understanding, encourage exploration, and enable students to solve more complex problems~~

2.PERFORMANCE OBJECTIVES:

2.1 Mathematical Analysis Standards:

2.1.1 Students are familiar with, and can apply, polar coordinates and vectors in the plane. In particular, they can translate between polar and rectangular coordinates and can interpret polar coordinates and vectors graphically.

2.1.2 Students are adept at the arithmetic of complex numbers. They can use the trigonometric form of complex numbers and understand that a function of a complex variable can be viewed as a function of two real variables. They know the proof of DeMoivre's theorem.

2.1.3 Students can give proofs of various formulas by using the technique of mathematical induction.

2.1.4 Students know the statement of, and can apply, the fundamental theorem of algebra.

2.1.5 Students are familiar with conic sections, both analytically and geometrically:

2.1.5.1 Students can take a quadratic equation in two variables; put it in standard form by completing the square and using rotations and translations, if necessary; determine what type of conic section the equation represents, and determine its geometric components (foci, asymptotes, and so forth).

2.1.5.2 Students can take a geometric description of a conic section – for example, the locus of points whose sum of its distances from (1,0) and (-1,0) is 6 – and derive a quadratic equation representing it.

2.1.6 Students find the roots and poles of a rational function and can graph the function and locate its asymptotes.

2.1.7 Students demonstrate an understanding of functions and equations defined parametrically and can graph them.

2.1.8 Students are familiar with the notion of the limit of a sequence and the limit of a function as the independent variable approaches a number or infinity. They determine whether certain sequences converge or diverge,

2.2 Trig**onometry Standards**

2.2.1 Students understand the notion of angle and how to measure it, in both degrees and radians. They can convert between degrees and radians.

2.2.2 Students know the definition of sine and cosine as y- and x-coordinates of points on the unit circle and are familiar with the graphs of the sine and cosine functions.

2.2.3 Students know the identity cos() + sin (x) = 1:

2.2.3.1 Students prove that this identity is equivalent to the Pythagorean theorem (i.e., students can prove this identity by using the Pythagorean theorem and, conversely, they can prove the Pythagorean theorem as a consequence of this identity).

2.2.3.2 Students prove other trigonometric identities and simplify others by using the identity cos(x)+sin" (x) = 1. For example, students use this identity to prove that sec" (x) = tan" (x) +1.

2.2.4 Students graph functions of the form *10) = A* sin *(Bt+C) or f(0) = A cos (Bt +* C) and interpret *A, B,* and C in terms of amplitude, frequency, period, and phase shift.

2.2.5 Students know the definitions of the tangent and cotangent functions and can graph them.

2.2.6 Students know the definitions of the secant and cosecant functions and can graph them.

2.2.7 Students know that the tangent of the angle that a line makes with the x-axis is equal to the slope of the line.

2.2.8 Students know the definitions of the inverse trigonometric functions and can graph the functions.

2.2.9 Students compute, by hand, the values of the trigonometric functions and the inverse trigonometric functions at various standard points.

2.2.10 Students demonstrate an understanding of the addition formulas for sines and cosines and their proofs and can use those formulas to prove and/or simplify other trigonometric identities.

2.2.11 Students demonstrate an understanding of half angle and double angle formulas for sines and cosines and can use those formulas to prove and/or simplify other trigonometric identities,

2.2.12 Students use trigonometry to determine unknown sides or angles in right triangles.

2.2.13 Students know the law of sines and the law of cosines and apply those laws to solve problems.

2.2.14 Students determine the area of a triangle, given one angle and the two adjacent sides.

2.2.15 Students are familiar with polar coordinates. In particular, they can determine polar coordinates of a point given in rectangular coordinates and vice versa.

2.2.16 Students represent equations given in rectangular coordinates in terms of polar coordinates.

2.2.17 Students are familiar with complex numbers. They can represent a complex number in polar form and know how to multiply complex numbers in their polar form.

2.2.18 Students know DeMoivre's theorem and can give nth roots of a complex number given in polar form.

2.2.19 Students are adept at using trigonometry in a variety of applications and word problems.

2.3 Linear Algebra Standards 2.3.1 Students demonstrate an understanding that linear systems are inconsistent (have no solutions), have exactly one solution, or have infinitely many solutions. (6.0)

2.3.2 Students demonstrate an understanding of the geometric interpretation of vectors and vector addition (by means of parallelograms) in the plane and in three-dimensional space. (7.0)

2.3.3 Students compute the determinants of 2 x 2 and 3 x 3 matrices and are familiar with their geometric interpretations as the area and volume of the parallelepipeds spanned by the images under the matrices of the standard basis vectors in two dimensional and three dimensional spaces. (10,0)

2.3.4 Students compute the scalar (dot) product of two vectors in n - dimensional space and know that perpendicular vectors have zero dot product. (12.0)

3. CONTENT OUTLINE:

3.1 Functions

3.1.1 Evaluate domain and range of a function.

3.1.2 Perform the arithmetic of functions.

3.1.3 Evaluate the composition and inverse of functions.

3.1.4 Solve polynomial equations.

3.1.5 Apply the factor and the rational root theorem.

3.1.6 Determine existence of asymptotes (vertical of horizontal), symmetry and intercepts.

3.1.7 Use synthetic substitution to evaluate a function and the bounds for the value of a Function.

3.1.8 Sketch the graph of polynomial functions. Find the relative maximum and minimum.

3.2 Exponential & Logarithmic Functions
3.2.1 Understand and graph exponential and logarithmic functions. Know the domain and range of each function.
3.2.2 Translate between exponential and logarithmic functions. Know the inverse relationship.

3.2.3 Apply the basic properties of logarithmic functions.
3.2.4 Apply the product, quotient and power properties.
3.2.5 Solve exponential and logarithmic equations. Using base 10 and base e logarithms.
3.2.6 Solve problems such as compound interest, growth and decay.
3.3 Trigonometric Functions
3.3.1 Express angular measure in radians or degrees (including decimal and DMS form).
3.3.2 Draw graphs of the six trigonometric functions and the three inverse functions without a calculator.
3.3.3 Draw graphs of the form y= A sin B(x-C) +D without a calculator,
3.3.4 Find all solutions to trigonometric equations.
3.3.5 Prove trigonometric identities.
3.3.6 Solve triangles, including both right triangles and scalene triangles, using Law of Sines and Law of Cosines.
3.3.7 Solve trigonometric applications problems, including navigation, surveying, and angular velocity.
3.4 Complex Numbers
3.4.1 Express complex numbers in either rectangular or polar form and convert from each form to the other.
3.4.2 Perform complex number arithmetic (add, subtract, multiply, divide, and find reciprocal).
3.4.3 Find powers and all roots of a complex number using DeMoivre's Theorem.
3.4.4 Plot a complex number on the plane and state the absolute value.
3.5 Series and Sequences
3.5.1 Apply mathematical induction to prove or disprove statements.
3.5.2 Recognize arithmetic and geometric series and to calculate their sums.
3.5.3 Expand a binomial.
3.5.4 Determine the limit or a sequence or the nonexistence of a limit.
3.6 Vectors
3.6.1 Find geometric and algebraic representation of vectors in two and three dimensions.
3.6.2 Add and subtract vectors. Find scalar product, dot products and cross products.
3.6.3 Find vector compositions, parallel and perpendicular vectors.
3.6.4 Solve vector and parametric equations. 3.6.5 Use applications to solve; motion in a plane, force, area

~~and volume problems.~~
~~3.7 Analytical Geometry~~
~~3.7.1 Master proofs on the coordinate plane.~~
~~3.7.2 Know the equations of all conic sections.~~
~~3.7.3 Apply completing the square to determine standard form.~~
~~3.7.4 Solve systems of second degree equations.~~

COURSE CONTENT:

Unit 1: Relations, Functions, Graphs, and Trigonometry
This unit reviews the definition of functions and function notation. Functions values, domain, range, x-intercepts and y-intercepts are found analytically. Given functions and the corresponding graphs, students are able to determine function values, domain, range, and x- and y-intercepts. Students are also able to determine whether a given function is even, odd, or neither and are able to tell corresponding symmetry types. Students will study transformations of functions, including vertical and horizontal shift, reflection over the x- or y-axis, and vertical and horizontal dilation. Students will combine functions by arithmetic operations (addition, subtraction, multiplication and division). Students will also compose functions as a preview of chain rule for differentiation in Calculus. Students will be able to find inverse functions analytically, and they will prove two functions to be inverses of each other analytically and graphically.

At the end of the unit, students use mathematical models to approximate sets of data points, apply models such as direct variation, direct variation as an nth power, inverse variation, and joint variation.

Unit 2: Polynomial and Rational Functions
Students revisit important topics in quadratic functions such as the vertex formula, quadratic formula, vertex form, standard form, the determinant, graphing, factoring and solving quadratic equations. Then students will be able to graph polynomials in factored form or standard form finding the intercepts (zeros) and using end behavior determined by the lead coefficient and degree. Students will review long division and learn synthetic division, preparing them for factoring a polynomial. Students will then be able to use the Remainder and Factor Theorems to solve polynomials of degree three or higher. Based on the degrees of numerators and denominators, students will be able to sketch the graphs of rational functions by using features of discontinuities and vertical/horizontal/oblique asymptotes.

At the end of the unit, students may work on a group project applying how to find maximums and minimums in application problems analytically and using a graphing calculator. Students can also build polynomial functions as a product of linear functions to better understand the relations between the zeroes of the linear factors, the behavior of the linear factors and how that behavior plays into the product of the polynomial.

Unit 3: The Trigonometric Functions:
Students revisit angles in standard position in both degrees and radians. Students are able to fluidly convert between radians and degrees. Students study arc length and sector areas

in radian measurement, rather than the degree measurements they studied in Geometry. All six trigonometric ratios are introduced using the Unit Circle. By studying the unit circle, students deepen their understanding that angle measurements are not necessarily limited to between 0 and 180 degrees and that each coordinate point is related to a particular angle and its corresponding six trig ratios. The concept of periodicity is reviewed, and combined with the graphs of all six trig functions, students understand the periodicity of trig functions in graphs and the unit circle. Students will study inverse trig functions. For inverse functions to occur, restricted domains have to be applied to original trig functions in order for them to be one-to-one in a strict sense. Students will then be ready to solve simple trig equations either under a restricted domain or under an unrestricted domain which involves periodicity of trig functions. Students will be able to find all solutions using the unit circle.

At the end of the unit, students will be given a real world task that students will need to find its amplitude, period, phase shift and create a trigonometric function that models the situation.

Unit 4: Analytic Trigonometry:
Students recognize and write the fundamental trigonometric identities. Then students use the fundamental trigonometric identities to evaluate trigonometric functions and to simplify and rewrite trigonometric expressions. Students begin to encounter complex trigonometric identities and learn to develop a strategy for verifying those complex trigonometric identities. Then students learn to solve complex trigonometric equations involving multiple angles and quadratic types by using standard algebraic techniques. Students will learn to use sum and difference formulas, multiple-angle and product-sum formulas to evaluate trigonometric functions, verify identities and solve trigonometric equations.

At the end of the unit, students will prove the double angle formulas and use a graphical approach.

Unit 5: Exponential and Logarithmic Functions:
Students learn to graph basic exponential and logarithmic functions. They are able to determine x-intercepts and y-intercepts analytically and graphically. From the domain and range and also from the graphs of those two functions, students can understand and justify that the exponential functions and logarithmic functions are inverses of each other. Students will derive the logarithmic properties and use them to simplify expressions and equations. Students will solve problems and write functions based on data for growth and decay. This includes half-life and Newton's law of Cooling.

At the end of the unit, a group project applied exponential and logarithmic models using the regression capabilities.

Unit 6: Discrete Mathematics and Calculus Sequences and Series:
Students write the formulas for sequences recursively, explicitly, and using summation notation. They find the sum of a sequence by hand and using technology. Students will determine whether the sequence is arithmetic, geometric, or something else, and they calculate a term given the term number. They will apply sequences to solve amortization problems. They will also prove statements using mathematical induction. Finally, they will apply the Binomial Theorem to expand binomials and find specific terms in a binomial

expansion.

At the end of the unit, students will be given a scenario involving a local sandwich shop of bread choices, meat choices, cheese choices and condiment choices. Students will be asked to figure out how many different sandwiches could be made of different types. Students will be expected to figure these combinations using a formula and not by counting them. Students will then see the difference between permutations and combinations and develop each formula.

Unit 7: Limits, Derivatives, and Integrals:
Students understand and estimate the limit of a function using a table of values and a graph. From graphs, students are able to tell whether the limit of a function at a specific point exists by using one-sided limits from the left and from the right. From there, students are able to understand function continuity. Limits at infinity are explored. Students will learn to evaluate the limits by direct substitution or using simplification, rationalizing a numerator, or dividing the terms of a rational function by the highest power variable in the case of indeterminate forms.

At the end of the unit, students may complete Limits and Continuity Activity at Desmos.com. Students consider left and right limits as well as function values in order to develop an informal and introductory understanding of continuity. Students can also complete another Desmos activity, Functions and their Derivatives. In this activity students practice matching a function to its first and second derivatives. They'll create their own function, and after successfully matching it to its derivatives, submit it into the gallery as a challenge for their classmates to solve.

~~4.~~ TIME ESTIMATES:
Instructional sequences vary in length from a few days to several weeks

~~5. INSTRUCTIONAL MATERIALS:~~

~~5.1 District adopted textbooks 5.2 Supplementary and teacher created materials that include a career focus 5.3 Technology use when appropriate~~

COURSE MATERIALS

Authors	Copyright	Publisher	Title	Website
Michael Sullivan and Michael Sullivan III	2009	Pearson Prentice Hall	Precalculus Enhanced with Graphing Utilities	

Teacher support resources can also be found in the Educational Services Website and supplemental online curriculum (for ex. Apex).

~~6.~~ EVALUATION OF STUDENT PROGRESS:
~~Students communicate mathematically and demonstrate content knowledge in a variety of ways that lead to mathematical competence in their chosen careers. 6.1 Teacher observation~~

6.2 Written assignments 6.3 Quizzes and tests 6.4 Career based projects and portfolios 6.5 Rubrics

Assessment Methods:

- Summative assessment
- Formative Assessment

Formative:

- Mathematical Discourse
- Reflection questions
- Teacher observations/evidence
- Student discussions
- Quiz
- Exit ticket

Summative:

- Performance task
- Unit Assessment

CommitteeMembers:

Norma Meyerkorth	CHS
Brianne Whiteside	CHS
Suzette Blanke	CPHS
Robert Lovelace	CPHS
Angel Niedzielski	CPHS
Frank Bruketta	CVHS
Danielle Dell	CVHS
Susan Deeley	CVHS
Bodhi Young	CVHS
Kathleen Magana	MDHS
Steve Sankey	MDHS
Judith Cubillo	NHS
Ellen Dill	NHS
Rianne Pfaltzgraff	NHS
Sharon Simone	RMS
Leslie Addiego	YVHS
Mary Ditkof	YVHS
Kelly Donlon	YVHS
John Ghiozzi	YVHS

Sandy Bruketta	Curriculum Specialist (Curriculum & Instruction)

College Park	Joan Dahl, Teacher
Concord	Maxwell Cazanov, Teacher
Concord	Norma Meyerkorth, Teacher

Mt. Diablo	Kyle Kondo, Teacher
Mt. Diablo	Lisa Scranton, Teacher
Northgate	Gregory Lyons, Teacher
Ygnacio Valley	David Swenson, Teacher
Ygnacio Valley	Erica Huie, Teacher
Willow Creek Center	Jodi Masongsong, TOSA
	Jeanne Johnson, TOSA
	Angela Victor, TOSA