I. INTRODUCTION

A. Pre-calculus, Math 2412, is a four-semester-hour course. The course is an in-depth combined study of algebra, trigonometry, and other topics for calculus readiness and includes the study of elementary functions and their graphs including polynomial, rational, exponential, logarithmic, and trigonometric functions, and analytic geometry.

B. This course satisfies the mathematic requirement in most curricula. It is occupationally related and serves as preparation for careers in the fields of science, engineering, and mathematics. Please check your degree plan to determine the status of this course in your program of study.

C. In support of the objectives of the Texas core curriculum, the course provides significant exercise of students’ critical thinking, communication skills, empirical and quantitative skills, and teamwork. These objectives form a foundation of intellectual and practical skills that are essential for all learning.

   1. Critical thinking skills include creative thinking, innovation inquiry, and analysis, evaluation and synthesis of information
   2. Communication skills include effective development, interpretation and expression of ideas through written, oral and visual media.
   3. Empirical and quantitative skills include the ability to manipulate and analyze numerical data or observable facts to reach informed conclusions.

D. Prerequisite: A grade of C or higher in Math 1414.

II. LEARNING OUTCOMES

Upon successful completion of this course, Pre-calculus, the student will be able to:

A. Demonstrate and apply knowledge of the properties of functions. (F1, F2, F10)
B. Define and graph a quadratic function, polynomial function, and rational function. (F1, F2, F10)
C. Define and graph exponential and logarithmic functions. (F1, F2, F6)
D. Solve exponential and logarithmic equations. (F8, F9)
E. Solve application models involving the exponential and logarithmic functions. (F4, F5, F9)
F. Define radian measure and degree measure. (F1, F2, F5, F6)
G. Define the trigonometric functions using the unit circle. (F1, F2, F5, F6)
H. Define the trigonometric functions using right angle trigonometry.
   i. (F1, F2, F5, F6)
I. Graph the trigonometric functions. (F2, F10)
J. Define the inverse trigonometric functions. (F1, F2, F5, F6)
K. Verify trigonometric equations. (F8, F9)
L. Solve trigonometric equations. (F8, F9, F10)
M. Solve right triangles. (F4, F7, F12)
N. Solve an oblique triangle by using the law of sines and law of cosines. (F4, F7, F12)
O. Prove trigonometric identities. (F8, F9)
P. Find the area of a triangle using for cases SAS and SSS. (F3, F4, F10, F12)
Q. Add and subtract vectors algebraically and geometrically. (F8, F9, F10)
R. Find a vector given its magnitude and direction. (F8, F9, F10)
S. Find the dot product of two vectors and use the properties of the dot product. (F8, F9, F10)
T. Model with vectors. (F4, F5, F9)
U. Write the rectangular and polar form of a complex number. (F8, F9, F10)
V. Graph the conic sections: parabolas, ellipses, and hyperbolas. (F2, F10)
W. Graph a polar equation. (F2, F10)
X. Write equations of conic sections in polar form. (F8, F9, F10)
Y. Use electronic and other media, such as the computer and DVD, to reinforce and supplement the learning process. (F1, F2, F3, F4, F6)
Z. Analyze information, formulate a strategy, and determine and justify a solution. (F1, F3, F4, F9)
AA. Use mathematics as a language for reasoning, problem solving, and making connections. (F1, F3, F4, F9)
BB. Recognize and apply exponential, logarithmic, and trigonometric functions to solve real-world applications. (F1, F3, F4, F9)

III. INSTRUCTIONAL MATERIALS

The Instructional materials identified for this course are viewable through www.ctcd.edu/books

IV. COURSE REQUIREMENTS

A. Assignments are given in Enhanced WebAssign and are due as scheduled by your instructor. The instructor will monitor students’ progress in completing the assignments.

B. Students are expected to attend every class, to arrive at each class on time, and remain in class for the entire period. Instructors may choose to lower a student's
grade because of tardiness.

V. EXAMINATIONS

A. Examinations will be given at appropriate points during the semester. Each examination will be announced in class in advance. There will be two unit exams and a final exam.

B. Students who miss an exam should discuss with the instructor the circumstances surrounding the absence and options for completing the course.

VI. SEMESTER GRADE COMPUTATIONS

A. The semester average is derived from the homework, quizzes, unit exams, and REQUIRED comprehensive final exam in Enhanced WebAssign. You must take the final exam and score at least 50% to pass the course.

Final grades will follow the grade designation below:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>90-100%</td>
</tr>
<tr>
<td>B</td>
<td>80-89%</td>
</tr>
<tr>
<td>C</td>
<td>70-79%</td>
</tr>
<tr>
<td>D</td>
<td>60-69%</td>
</tr>
<tr>
<td>F</td>
<td>0-59%</td>
</tr>
</tbody>
</table>

VII. NOTES AND ADDITIONAL INSTRUCTIONS

A. **Withdrawal from Course:** It is the student's responsibility to officially drop a class if circumstances prevent attendance. Any student who desires to, or must, officially withdraw from a course after the first scheduled class meeting must file an Application for Withdrawal or an Application for Refund. The withdrawal form must be signed by the student.

An Application for withdrawal will be accepted at any time prior to Friday of the 12th week of classes during the 16-week fall and spring semesters. The deadline for sessions of other lengths is as follows.

6/5/17
<table>
<thead>
<tr>
<th>Session</th>
<th>Deadline for Withdrawal</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-week session</td>
<td>Friday of the 9th week</td>
</tr>
<tr>
<td>10-week session</td>
<td>Friday of the 7th week</td>
</tr>
<tr>
<td>8-week session</td>
<td>Friday of the 6th week</td>
</tr>
<tr>
<td>6-week session</td>
<td>Friday of the 4th week</td>
</tr>
<tr>
<td>5-week session</td>
<td>Friday of the 3rd week</td>
</tr>
</tbody>
</table>

The equivalent date (75% of the semester) will be used for sessions of other lengths. The specific last day to withdraw is published each semester in the Schedule Bulletin.

Students who officially withdraw will be awarded the grade of "W" provided the student's attendance and academic performance are satisfactory at the time of official withdrawal. Students must file a withdrawal application with the college before they may be considered for withdrawal.

A student may not withdraw from a class for which the instructor has previously issued the student a grade of "F" or "FN" for nonattendance.

B. **An Incomplete Grade:** The College catalog states, "An incomplete grade may be given in those cases where the student has completed the majority of the course work but, because of personal illness, death in the immediate family, or military orders, the student is unable to complete the requirements for a course..." Prior approval from the instructor is required before the grade of "I" is recorded. A student who merely fails to show for the final examination will receive a zero for the final and an "F" for the course.

C. **Cellular Phones and Beepers:** Cellular phones and beepers will be turned off while the student is in the classroom or laboratory.

D. **Americans With Disabilities Act (ADA):** Disability Support Services provide services to students who have appropriate documentation of a disability. Students requiring accommodations for class are responsible for contacting the Office of Disability Support Services (DSS) located on the central campus. This service is available to all students, regardless of location. Review the website at www.ctcd.edu/disability-support for further information. Reasonable accommodations will be given in accordance with the federal and state laws through the DSS office.

E. **Civility:** Individuals are expected to be cognizant of what a constructive educational experience is and respectful of those participating in a learning environment. Failure to do so can result in disciplinary action up to and including expulsion.

F. **Math Lab:** The Math Department operates an Advanced Mathematics Lab in
Building 152, Room 145. All courses offered by the Math Department are supported in the lab with appropriate tutorial software. Calculators and Graphlink are available for student use in the lab. Students are encouraged to take advantage of these resources. See posted hours for the Math Lab.

G. **Office Hours:** Full-time instructors post office hours in Blackboard. Part-time instructors may be available by appointment. If you have difficulty with the course work, please consult your instructor.

**VIII. COURSE OUTLINE**

A. **Lesson One:** Exponential and Logarithmic Functions (Chapters 1 and 3)

1. **Learning Outcomes:** Upon successful completion of this unit, the student will be able to:

   a. Determine if a relation is a function.
   b. Analyze the graphs of functions.
   c. Use transformations to sketch graphs of functions.
   d. Form a composite function.
   e. Find the domain of a composite function.
   f. Determine whether a function is one-to-one.
   g. Determine the inverse of a function defined by a map or a set of ordered pairs.
   h. Obtain the graph of the inverse function from the graph of the function.
   i. Find the inverse of a function defined by an equation.
   j. Evaluate and graph exponential functions.
   k. Define the number $e$.
   l. Solve exponential equations.
   m. Change exponential expressions to logarithmic expressions and logarithmic expressions to exponential expressions.
   n. Evaluate logarithmic expressions.
   o. Determine the domain of a logarithmic function.
   p. Graph logarithmic functions.
   q. Solve logarithmic equations.
   r. Work with the properties of logarithms.
   s. Write a logarithmic expression as a sum or difference of logarithms.
   t. Write a logarithmic expression as a single logarithm.
   u. Evaluate logarithms whose base is neither 10 nor $e$.
   v. Solve logarithmic and exponential equations.
   w. Determine future value of a lump sum of money.
   x. Calculate effective rates of return.
   y. Determine the present value of a lump sum of money.
   z. Determine the rate of interest or time required to double a lump sum of money.
   aa. Find equations of populations that obey the law of uninhibited growth.
bb. Find equations of populations that obey the law of decay.
c. Use Newton’s Law of Cooling.
dd. Use logistic models.

ee. Use a graphing utility to fit an exponential function, logarithmic function and logistic function to data.

2. Learning Activities:

   a. Read pages of assigned chapters. (F1)
   b. Listen to classroom lecture and discuss exercises. (F5, F6, F7, F8)
   c. Work section, chapter, and computer problems assigned by instructor. (F2, F7, F8, F9, F10, F11, F12)

3. Lesson Outline:

   a. Section 1.4 (Functions)
   b. Section 1.5 (Analyzing Graphs of Functions)
   c. Section 1.6 (A Library of Parent Functions)
   d. Section 17. (Transformations of Functions)
   e. Section 1.8 (Composite Functions)
   f. Section 1.9 (Inverse Functions)
   g. Section 3.1 (Exponential Functions and Their Graphs)
   h. Section 3.2 (Logarithmic Functions and Their Graphs)
   i. Section 3.3 (Properties of Logarithms)
   j. Section 3.4 (Logarithmic and Exponential Equations)
   k. Section 3.5 (Exponential and Logarithmic Models)

C. Lesson Two: Trigonometry (Chapter 4)

1. Learning Outcomes: Upon successful completion of this unit, the student will be able to:

   a. Convert from degrees to radians and from radians to degrees.
   b. Find the arc length of a circle.
   c. Find the area of a sector of a circle.
   d. Find the linear speed of an object traveling in circular motion.
   e. Find the exact values of the trigonometric functions using a point on the unit circle.
   f. Find the exact values of the trigonometric functions of quadrant angles.
   g. Use a calculator to approximate the value of a trigonometric function.
   h. Determine the domain and range of trigonometric functions.
   i. Determine the period of the trigonometric functions.
   j. Determine the signs of the trigonometric functions in a given quadrant.
k. Find the values of the trigonometric functions using fundamental identities.
l. Find the exact values of the trigonometric functions of an angle given one of the functions and the quadrant angle.
m. Use even-odd properties to find the exact values of the trigonometric functions.
n. Sketch the graphs of basic sine and cosine functions
o. Use transformations to sketch the graphs of sine and cosine functions.
p. Find an equation for a sinusoidal graph.
q. Sketch the graphs of tangent, cotangent, secant, and cosecant functions.
r. Sketch the graphs of damped trigonometric functions.
s. Evaluate and graph the inverse trigonometric functions.
t. Evaluate the composition of trigonometric functions.
u. Solve real-life problems using trigonometry.

2. Learning Activities:

a. Read pages of assigned chapter. (F1)
b. Listen to classroom lecture and discuss exercises. (F5, F6, F7, F8)
c. Work section, chapter, and computer problems assigned by instructor. (F2, F7, F8, F9, F10, F11, F12)

3. Lesson Outline:

a. Section 4.1 (Radian and Degree Measure)
b. Section 4.2 (Trigonometric Functions: Unit Circle)
c. Section 4.3 (Right Triangle Trigonometry)
d. Section 4.4 (Trigonometric Functions of Any Angle)
e. Section 4.5 (Graphs of Sine and Cosine Functions)
f. Section 4.6 (Graphs of Other Trigonometric Functions)
g. Section 4.7 (Inverse Trigonometric Functions)
h. Section 4.8 (Applications and Models)

D. Lesson Three: Analytic Trigonometry (Chapter 5)

1. Learning Outcomes: Upon successful completion of this unit, the student will be able to:

a. Use the fundamental trigonometric identities to evaluate trigonometric functions, simplify trigonometric expressions, and
rewrite trigonometric expressions.
b. Verify trigonometric identities.
c. Use standard algebraic techniques to solve trigonometric equations.
d. Use inverse trigonometric functions to solve trigonometric equations.
e. Use sum and difference formulas to evaluate trigonometric functions, verify identities, and solve trigonometric equations.
f. Use double-angle formulas to find rewrite and evaluate trigonometric functions.
g. Use half-angle formulas to rewrite and evaluate trigonometric functions.
h. Use product-to-sum and sum-to-product formulas to rewrite and evaluate trigonometric functions.
i. Use trigonometric formulas to rewrite real-life problems.

2. **Learning Activities.**

a. Read pages of assigned chapter. (F1)
b. Listen to classroom lecture and discuss exercises. (F5, F6, F7, F8)
c. Work section, chapter, and computer problems assigned by instructor. (F2, F7, F8, F9, F10, F11, F12)

3. **Lesson Outline:**

a. Section 5.1 (Using Fundamental Identities)
b. Section 5.2 (Verifying Trigonometric Identities)
c. Section 5.3 (Solving Trigonometric Equations)
d. Section 5.4 (Sum and Difference Formulas)
e. Section 5.5 (Multiple Angle and Product to Sum Formulas)

F. **Lesson Four: Additional Topics in Trigonometry (Chapter 6)**

1. **Learning Outcomes:** Upon successful completion of this unit, the student will be able to:

   a. Use the Law of Sines to solve AAS, ASA, ASS triangles.
b. Use the Law of Sines to solve real-life problems.
c. Use the Law of Cosines to solve SSS or SAS triangles.
d. Use the Law of Cosines to solve real-life problems.
e. Use Heron’s Formula to find the area of a triangle.
f. Perform basic vector operations and represent them graphically.
g. Use vectors to model and solve real-life problems.
h. Find the dot product of two vectors and use the properties of the dot product.

i. Use Vectors to find the work done by a force.

j. Plot complex numbers in the complex plane.

k. Perform operations with complex numbers in the complex plane.

l. Use the Distance and Midpoint Formulas in the complex plane.

m. Write the trigonometric form of complex numbers.

n. Multiply and divide complex numbers written in trigonometric form.

o. Use DeMoivre’s Theorem to find powers of complex numbers.

p. Find the \( n^{\text{th}} \) root of a complex number.

2. Learning Activities:

   a. Read pages of assigned chapter. (F1)
   
   b. Listen to classroom lecture and discuss exercises. (F5, F6, F7, F8)
   
   c. Work section, chapter, and computer problems assigned by instructor. (F2, F7, F8, F9, F10, F11, F12)

3. Lesson Outline:

   a. Section 6.1 (Law of Sines)
   
   b. Section 6.2 (Law of Cosines)
   
   c. Section 6.3 (Vectors in the Plane)
   
   d. Section 6.4 (Vectors and the Dot Product)
   
   e. Section 6.5 (The Complex Plane)
   
   f. Section 6.6 (Trigonometric Form of a Complex Number)

G. Lesson Five: Topics in Analytic Geometry (Chapter 10)

1. Learning Outcomes: Upon successful completion of this unit, the student will be able to:

   a. Find the inclination of a line.
   
   b. Find the angle between two lines.
   
   c. Find the distance between a point and a line.
   
   d. Use the reflective property of parabolas to solve real-life problems.
   
   e. Write equations of ellipses in standard form and graph ellipses.
   
   f. Use properties of ellipses to model and solve real-life problems.
   
   g. Find eccentricities of ellipses.
   
   h. Write equations of hyperbolas in standard form and graph hyperbolas.
   
   i. Use properties of hyperbolas to solve real-life problems.
j. Classify conics from their general equations.
k. Rotate the coordinate axes to eliminate the xy-term.
l. Use the discriminant to classify conics.
m. Evaluate parametric equations for given parameters.
n. Rewrite parametric equations as rectangular equations.
o. Find sets of parametric equations for graphs.
p. Plot points in the polar coordinate system.
q. Convert points from rectangular to polar form and vice versa.
r. Convert equations from rectangular to polar form and vice versa.
s. Graph polar equations.
t. Define conics in terms of eccentricity and write and graph equations of conics in polar form.
u. Use equations of conics in polar form to model real-life problems.

2. **Learning Activities:**
   a. Read pages of assigned chapter. (F1)
   b. Listen to classroom lecture and discuss exercises. (F5, F6, F7, F8)
   c. Work section, chapter, and computer problems assigned by instructor. (F2, F7, F8, F9, F10, F11, F12)

3. **Lesson Outline:**
   a. Section 10.1 (Lines)
   b. Section 10.2 (Introduction to Conics: Parabolas)
   c. Section 10.3 (Ellipses)
   d. Section 10.4 (Hyperbolas)
   e. Section 10.5 (Rotation of Conics)
   f. Section 10.6 (Parametric Equations)
   g. Section 10.7 (Polar Coordinates)
   h. Section 10.8 (Graphs of Polar Equations)
   i. Section 10.9 (Polar Equations of Conics)