I. INTRODUCTION

A. Pre-calculus, Math 2412, is a four-semester-hour course. The course covers such topics as functions and their graphs, polynomial and rational functions, exponential and logarithmic functions, trigonometry, analytic trigonometry, polar equations, and analytic geometry.

B. This course satisfies the mathematic requirement in most curricula. Please check your degree plan to determine the status of this course in your program of study.

C. This course is occupationally related and serves as preparation for careers in sciences, social sciences, and business.

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. Define and graph a quadratic function, polynomial function, and rational function. (F1, F2, F10)
B. Define and graph exponential and logarithmic functions. (F1, F2, F6)
C. Solve exponential and logarithmic equations. (F8, F9)
D. Solve application models involving the exponential and logarithmic functions. (F4, F5, F9)
E. Define radian measure and degree measure. (F1, F2, F5, F6)
F. Define the trigonometric functions using the unit circle. (F1, F2, F5, F6)
G. Define the trigonometric functions using right angle trigonometry. (F1, F2, F5, F6)
H. Graph the trigonometric functions. (F2, F10)
I. Define the inverse trigonometric functions. (F1, F2, F5, F6)
J. Verify trigonometric equations. (F8, F9)
K. Solve trigonometric equations. (F8, F9, F10)
L. Solve an oblique triangle by using the law of sines and law of cosines. (F4, F7, F12)
M. Find the area of a triangle using for cases SAS and SSS. (F3, F4, F10, F12)
P. Add and subtract vectors algebraically and geometrically. (F8, F9, F10)
Q. Find a vector given its magnitude and direction. (F8, F9, F10)
R. Model with vectors. (F4, F5, F9)
S. Write the rectangular and polar form of a complex number. (F8, F9, F10)
T. Graph the conic sections: parabolas, ellipses, and hyperbolas. (F2, F10)
U. Graph a polar equation. (F2, F10)
V. Write equations of conic sections in polar form. (F8, F9, F10)
W. Use electronic and other media, such as the computer and DVD, to reinforce and supplement the learning process. (F1, F2, F3, F4, F6)

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 MyMathLab 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. Students who are absent from class 12.5% of the number of class meetings for any reason will be dropped from the class with a grade of "F". 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 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.

7/7/14
VI. SEMESTER GRADE COMPUTATIONS

A. The semester average is derived from the homework, quizzes, unit exams, and comprehensive final exam in MyMathLab in accordance with the weights below:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homework</td>
<td>10%</td>
</tr>
<tr>
<td>Quizzes</td>
<td>10%</td>
</tr>
<tr>
<td>Chapter Labs</td>
<td>10%</td>
</tr>
<tr>
<td>Unit 1 Exam</td>
<td>20%</td>
</tr>
<tr>
<td>Unit 2 Exam</td>
<td>20%</td>
</tr>
<tr>
<td>Final Exam</td>
<td>30%</td>
</tr>
</tbody>
</table>

B. Final grades will follow the grade designation below:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Class Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>“A”</td>
<td>90 to 100</td>
</tr>
<tr>
<td>“B”</td>
<td>80 to 89</td>
</tr>
<tr>
<td>“C”</td>
<td>70 to 79</td>
</tr>
<tr>
<td>“D”</td>
<td>60 to 69</td>
</tr>
<tr>
<td>“F”</td>
<td>0 to 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.

<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 Administrative Withdrawal**: An administrative withdrawal may be initiated when the student fails to meet College attendance requirements. The instructor will assign the appropriate grade on the Administrative Withdrawal Form for submission to the registrar.

C. **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.

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

E. **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.

F. **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.

G. **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.

H. **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. Unit One: Polynomial and Rational Functions (Chapter 4)

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

   a. Identify polynomial functions and their degree.
   b. Analyze the graph of a polynomial function.
   c. Find the domain of a rational function.
   d. Find the vertical asymptotes of a rational function.
   e. Find the horizontal or oblique asymptotes of a rational function.
   f. Analyze the graph of a rational function.
   g. Solve polynomial and rational inequalities.
   h. Use the Remainder and Factor Theorems.
   i. Use Descartes’ Rule of Signs to determine the number of positive and the number of negative real zeros of a polynomial function.
   j. Use the Rational Zeros Theorem to list the potential rational zeros of a polynomial function.
   k. Find the real zeros of a polynomial function.
   l. Solve polynomial equations.
   m. Use the Theorem for Bounds on zeros.
   n. Use the Intermediate Value Theorem.
   o. Use the Conjugate Pairs Theorem.
   p. Find a polynomial function with specified zeros.
   q. Find the complex zeros of a polynomial.

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. Unit Outline:

   a. Section 4.1 (Polynomial Functions and Models)
   b. Section 4.1 (Properties of Rational Functions)
   c. Section 4.3 (The Graph of a Rational Function)
   d. Section 4.4 (Polynomial and Rational Inequalities)
   e. Section 4.5 (The Real Zeros of a Polynomial Function)

7/7/14
f. Section 4.6 (Complex Zeros: Fundamental Theorem of Algebra)

B. **Unit Two:** Exponential and Logarithmic Functions (Chapter 5)

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

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

a. Section 5.1 (Composite Functions)
b. Section 5.2 (One-to-One Functions; Inverse Functions)
c. Section 5.3 (Exponential Functions)
d. Section 5.4 (Logarithmic Functions)
e. Section 5.5 (Properties of Logarithms)
f. Section 5.6 (Logarithmic and Exponential Equations)
g. Section 5.7 (Financial Models)
h. Section 5.8 (Exponential Growth and Decay Models; Newton’s Law; Logistic Growth and Decay Models)
i. Section 5.9 (Building Exponential, Logarithmic, and Logistic Functions from Data)

C. **Unit Three: Trigonometry (Chapter 6)**

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

a. Convert between decimals and degrees, minutes, seconds form for angles.
b. Find the arc length of a circle.
c. Convert from degrees to radians and from radians to degrees.
d. Find the area of a sector of a circle.
e. Find the linear speed of an object traveling in circular motion.
f. Find the exact values of the trigonometric functions using a point on the unit circle.
g. Find the exact values of the trigonometric functions of quadrantal angles.
h. Use a calculator to approximate the value of a trigonometric function.
i. Use a circle of radius $r$ to evaluate the trigonometric functions.
j. Determine the domain and range of trigonometric functions.
k. Determine the period of the trigonometric functions.
l. Determine the signs of the trigonometric functions in a given quadrant.
m. Find the values of the trigonometric functions using fundamental
identities.
n. Find the exact values of the trigonometric functions of an angle
given one of the functions and the quadrant angle.
o. Use even-odd properties to find the exact values of the
trigonometric functions.
p. Graph functions in the form \( y = A \sin (wx) \) and \( y = A \cos (wx) \)
using transformations.
q. Determine the amplitude and period of sinusoidal functions.
r. Graph sinusoidal functions using key points.
s. Find an equation for a sinusoidal graph.
t. Graph functions in the form \( y = A \tan (wx) + B \) and \( y = A \cot (wx) + B \).
u. Graph functions of the form \( y = A \csc (wx) + B \) and \( y = A \sec (wx) + B \).
v. Graph sinusoidal functions and find a sinusoidal function from
data.

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. **Unit Outline:**

a. Section 6.1 (Angles and Their Measure)
b. Section 6.2 (Trigonometric Functions: Unit Circle Approach)
c. Section 6.3 (Properties of the Trigonometric Functions)
d. Section 6.4 (Graphs of the Sine and Cosine Functions)
e. Section 6.5 (Graphs of the Tangent, Cotangent, Cosecant, and
   Secant Functions)
f. Section 6.6 (Phase Shift; Sinusoidal Curve Fitting)

D. **Unit Four:** Analytic Trigonometry (Chapter 7)

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

a. Find the exact value of inverse sine, cosine, and tangent functions.
b. Find an approximate value of inverse sine, cosine, and tangent
   functions.

7/7/14
c. Use properties of inverse functions to find exact values of certain composite functions.

d. Find the inverse function of a trigonometric function.

e. Solve equations involving inverse trigonometric functions.

f. Find the exact value of expressions involving the inverse sine, cosine, and tangent functions.

g. Know the definition of the inverse secant, cosecant, and cotangent functions.

h. Use a calculator to evaluate sec⁻¹ x, csc⁻¹ x, and cot⁻¹ x.

i. Write a trigonometric expression as an algebraic expression.

j. Use algebra to simplify trigonometric expressions.

k. Establish identities.

l. Use sum and difference formulas to find exact values and establish identities.

m. Use sum and difference formulas involving inverse trigonometric functions.

n. Use double-angle formulas to find exact values and establish identities.

o. Use half-angle formulas to find exact values.

p. Express products as sums.

q. Express sums as products.

r. Solve equations involving a single trigonometric function.

s. Solve trigonometric equations quadratic in form.

t. Solve trigonometric equations using identities.

u. Solve trigonometric equations linear in sine and cosine.

v. Solve trigonometric equations using a graphing utility.

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. Unit Outline:

a. Section 7.1 (The Inverse Sine, Cosine, and Tangent Functions)

b. Section 7.2 (The Inverse Trigonometric Functions, Continued)

c. Section 7.3 (Trigonometric Equations)

d. Section 7.4 (Trigonometric Identities)

e. Section 7.5 (Sum and Difference Formulas)

f. Section 7.6 (Double-angle and Half-angle Formulas)

g. Section 7.7 (Product-to-Sum and Sum-to-Product Formulas)
Unit Five: Applications of Trigonometric Functions (Chapter 8)

1. **Learning Outcomes:** Upon successful completion of this unit, the student will be able to:
   
a. Find the value of trigonometric functions of acute angles.
b. Use the Complementary Angle Theorem.
c. Solve right triangles.
d. Solve applied problems.
e. Solve SAA, ASA, SSA, and SSS triangles.
f. Find the area of SAS and SSS triangles.
g. Find an equation for an object in simple harmonic motion.
h. Analyze simple harmonic motion.
i. Analyze an object in damped motion.
j. Graph the sum of two functions.

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. **Unit Outline:**
   
a. Section 8.1 (Right Triangle Trigonometry; Applications)
b. Section 8.2 (The Law of Sines)
c. Section 8.3 (The Law of Cosines)
d. Section 8.4 (Area of a Triangle)
e. Section 8.5 (Simple Harmonic Motion; Damped Motion; Combining Waves)

Unit Six: Polar Coordinates; (Chapter 9)

1. **Learning Outcomes:** Upon successful completion of this unit, the student will be able to:
   
a. Plot points using polar coordinates.
b. Convert from polar coordinates to rectangular coordinates.
c. Convert from rectangular coordinates to polar coordinates.
d. Transform equations from polar to rectangular form.
e. Graph and identify polar equations by converting to rectangular
equations.
f. Evaluate polar equations for symmetry.
g. Graph polar equations by plotting points.
h. Convert a complex number from rectangular form to polar form.
i. Plot points in the complex plane.
j. Find products and quotients of complex numbers in polar form.
k. Use DeMoivre’s Theorem.
l. Find complex roots.
m. Add and Subtract vectors algebraically and geometrically.
n. Find a unit vector.
o. Find a vector from its direction and magnitude.
p. Model with vectors.

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. **Unit Outline:**

a. Section 9.1 (Polar Coordinates)
b. Section 9.2 (Polar Equations and Graphs)
c. Section 9.3 (The Complex Plane; DeMoivre’s Theorem)
d. Section 9.4 (Vectors)

**Unit Seven:** Analytic Geometry (Chapter 10)

1. **Learning Outcomes:** Upon successful completion of this unit, the student will be able to:
a. Know the name of conics.
b. Analyze parabolas with vertex at the origin and the vertex at (h, k).
c. Solve applied problems involving parabolas.
d. Analyze ellipses with center at the origin and center at (h, k).
e. Solve applied problems involving ellipses.
f. Analyze hyperbolas with center at the origin and center at (h, k).
g. Find the asymptotes of a hyperbola.
h. Solve applied problems involving hyperbolas.
i. Identify a conic.
j. Use a rotation of axes to transform equations.
k. Analyze an equation using a rotation of axes.
l. Identify conics without a rotation of axes.
m. Analyze and graph polar equations of conics.
n. Convert the polar equation of a conic to a rectangular equation.
o. Graph parametric equations.
p. Find a rectangular equation for a curve defined parametrically.
q. Use time as a parameter in parametric equations.
r. Find parametric equations for curves defined by rectangular equations.

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. Unit Outline:

a. Section 10.1 (Conics)
b. Section 10.2 (The Parabola)
c. Section 10.3 (The Ellipse)
d. Section 10.4 (The Hyperbola)
e. Section 10.5 (Rotation of Axes; General Form of a Conic)
f. Section 10.6 (Polar Equations of Conics)
g. Section 10.7 (Plane Curves and Parametric Equations)