TCC Teaching Mission Statement

The Faculty is committed to creating a learning environment for all students which promotes, encourages, and fosters higher-order thinking and critical thinking skills that are grounded in an understanding of the fundamental concepts of the disciplines in which they are taught.


Course Description: MAC 2147 Precalculus Algebra/Trigonometry (5 ) F, Sp, Sm. Prerequisites: (1) Completion of MAC1105 with a grade of A or B plus completion of a high school Trigonometry course with a grade of A or B, or (2) appropriate score on the College Level Math (CLM) placement test. This course serves as a prerequisite for MAC2311, Calculus with Analytic Geometry I. Topics include: properties and graphs of polynomial, rational, exponential, and logarithmic functions; solutions of higher degree polynomial equations; solutions of systems of equations using matrices and determinants; sequences and series; the binomial theorem; an introduction to conic sections; trigonometric functions of angles and real numbers, along with their graphs and inverses; solutions of triangles and other applications; trigonometric identities; conditional trigonometric equations; complex numbers in trigonometric form and DeMoivre’s Theorem; vectors and polar coordinates; and piecewise defined functions. A graphing calculator is required. Please check with your instructor for the most appropriate one for the course. This course may not be taken for credit by any student who already has a grade in MAC2140 or in MAC 2114. Lecture, 5 hours college credit.

Objective of the Course: To combine Precalculus Algebra and Trigonometry into one 5 semester-hour course in order to allow students with adequate mathematics background to complete the prerequisites for Calculus I in one course instead of two. This would possibly reduce the number of excess hours a student who is majoring in science, engineering, or mathematics may need to take.

Course Outline:

1. Polynomial, rational, and other algebraic functions, their properties and graphs
2. Exponential and logarithmic functions, their properties and graphs
3. Conic sections
4. Matrices and determinants
5. Sequences and series
6. Binomial theorem
7. Trigonometric functions, their properties and graphs
8. Inverse trigonometric functions, their properties and graphs
9. Trigonometric identities
10. Conditional trigonometric equations
11. Solutions of triangles
12. Vector algebra
13. Polar coordinates
14. Piecewise defined functions
15. Applications

Requirements of the Course:

The student must possess a graphing calculator and be proficient in its use for this course; complete assignments and quizzes as assigned by the instructor; and take four or five unit tests and the comprehensive final exam.

Teaching Aids and Devices:

1. Graphing calculator (such as the Texas Instruments TI-83plus)
2. View screen for projecting graphing calculator screen
3. One or two overhead projectors per classroom

References and Source Materials:

1. Student solutions manual
2. Video tapes and other topical materials in the Math Lab

Factors Considered in Evaluating and Grading Students:

<table>
<thead>
<tr>
<th>GRADING SCALE</th>
<th>METHOD TO DETERMINE THE GRADE</th>
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<tbody>
<tr>
<td>A = 90 - 100</td>
<td>Quiz/HW Average = 1 test grade</td>
</tr>
<tr>
<td>B = 80 - 89</td>
<td>Average of 4 unit tests and Quiz/HW average=75%</td>
</tr>
<tr>
<td>C = 70 - 79</td>
<td>Cumulative Final Exam = 25%</td>
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<td>D = 60 - 69</td>
<td></td>
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<tr>
<td>F = 0 - 59</td>
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One goal of the college is to foster critical thinking. Course learning objectives integrate the range of higher-order thinking skills as described by Bloom. The six categories, listed in order of increasing complexity, are:

1. Remember – to retrieve relevant knowledge from long-term memory
2. Understand – to construct meaning from instruction (oral, written, graphical, etc.)
3. Apply – to use a procedure
4. Analyze – to break material into constituent parts and relate to each other and the whole
5. Evaluate – to make criterion-based judgments
6. Create – to put elements together to form coherent whole, to reorganize, etc.

Performance Goals of the Course: Upon the completion of this course, the student should be able to:

1. Use and define trigonometric terminology concerning standard position of any angle, positive or
2. Know the radian measure for angles that are multiples of 1/4 and 1/6 of the circumference of a unit circle.

3. Write all angles coterminal with a given angle; find the measure of the least positive angle coterminal with any given angle.

4. Convert any angle given in degrees to radians, and in radians to degrees.

5. Find the length of an arc intercepted by a given central angle on a circle of given radius.

6. Find the linear and angular speed of an object in circular motion.

7. Know the coordinates of the points associated with arc lengths of multiples of $\pi/6$ and $\pi/4$.

8. Give the trigonometric function values of multiples of $\pi/4$ and $\pi/6$ without using tables or a calculator.

9. Define the six trigonometric functions by use of the unit circle.

10. Find the function values of any angle measure or any real number using a hand calculator.

11. Define the trigonometric functions in terms of the lengths of the sides of a right triangle.

12. State the reciprocal trigonometric functions.

13. State and prove the Pythagorean identities.

14. Given one function value of an acute angle, find the other five function values of the angle.

15. Know what is meant by "solving" a right triangle.

16. Solve right triangles and applied problems involving them, and gain facility in the use of graphing calculators in solving trigonometry problems.

17. Define the trigonometric functions in terms of angles in standard position using $x$, $y$, and $r$.

18. Give the domain and range of the six trigonometric functions and tell in which quadrants the functions values are positive or negative.

19. Given one function value of an angle and some additional information (e.g., the quadrant in which it terminates or that some function value is negative), find the other five function values of the angle.

20. Sketch the graphs of $y = a \sin (bx - c)$ and $y = a \cos (bx - c)$, and determine amplitude, period, and phase shift; sketch the graph of $y = a \tan (bx - c)$ and determine period and phase shift.

21. Sketch the graphs of the six trigonometric functions and give their period, domain, and range.

22. Use addition of ordinates or the graphing calculator to graph the sum of two functions. (optional)

23. Define and use the inverse functions of the trigonometric functions.

24. Give the domain and range of the arcsin, arccos, and arctan functions; graph these three inverse functions; give the domain and range of the arcsec, arccsc, and arccot functions; find function values.

25. Simplify expressions involving compositions of functions and inverses [e.g., $\cos (\arcsin (a/b))]$.

26. Use the basic identities to verify other identities.

27. Solve trigonometric equations, including those involving half-angles and multiple angles.

28. State all and prove at least some of the sum and difference formulas for sin, cos, and tan.

29. Use the formulas in #28 to find function values and to simplify selected trigonometric expressions.

30. State and use the cofunction identities for sin, cos, and tan.

31. State all and prove at least some of the half-angle and double angle formulas for sin, cos, and tan.

32. Use the half-angle and double-angle formulas for sin, cos, and tan.

33. Use the double-angle (half-angle) identities to find function values of twice (half) an angle when the value of one of its functions is given.

34. State the identities for trigonometric functions of (-θ).


37. Find the area of a triangle using the formula \( \text{Area} = \frac{1}{2}ab \sin \theta \).
38. Find the area of a triangle using Heron's formula. (optional)
39. Graph and use vectors given their magnitudes and direction angles.
40. Work with two-dimensional vectors as ordered pairs of real numbers.
41. Find the resultant of two vectors both algebraically and geometrically.
42. Identify the scalar multiple of a vector.
43. State all and prove some of the properties of vectors under the operations of vector addition and multiplication by a scalar.
44. Solve applied problems involving vector sums.
45. Resolve a vector into a linear combination of the unit vectors \( \mathbf{i} \) and \( \mathbf{j} \).
46. Find the dot product of two vectors.
47. Find the angle between two vectors given in component form.
48. Solve applications such as work problems or orthogonal projections. (optional)
49. Define and graph complex numbers.
50. Change a complex number given in trigonometric form to standard form \( (a + bi) \), and vice-versa.
51. State and use the theorems for product and quotients of complex numbers in trigonometric form.
52. State DeMoivre's Theorem and use it to raise a complex number to a positive integer power.
53. Find the \( n \)th roots of a complex number.
54. Find all solutions to polynomial equations of the form \( x^n + c = 0 \).
55. Change a point written in rectangular coordinates to polar coordinates, and vice-versa.
56. Transform an equation in polar form to rectangular form and vice-versa.
57. Know the definition of polynomial functions and the characteristics of their graphs, with emphasis on local behavior and end behavior.
58. Use a graphing calculator to approximate the x-intercepts of the graph of a polynomial function.
59. Use long division on polynomials to find the quotient and the remainder, and correctly write the polynomial in the form \( P(x) = Q(x) D(x) + R(x) \).
60. Use, and interpret the results of, synthetic division when dividing a polynomial by \( x - c \), \( c \) is a real number.
61. State, prove, and use the Remainder Theorem and the Factor Theorem.
62. List all possible rational zeros of a polynomial with integer coefficients. Identify multiplicity of roots in factored polynomials.
63. Use Descartes’ Rule of Signs to determine the possible number of positive real zeros and negative real zeros of a polynomial.
64. Find the smallest positive integer upper bound and the largest negative integer lower bound for the real roots of a polynomial equation, using synthetic division.
65. Perform arithmetic operations on complex numbers.
66. Graph a complex number and find its modulus and its conjugate.
67. State the Fundamental Theorem of Algebra.
68. Use the Conjugate Roots Theorem and the Complete Factorization Theorem to find a polynomial equation having a given rational number and a given nonreal number as two of its roots.
69. Explain why the Conjugate Roots Theorem guarantees that a polynomial of odd degree and real coefficients has at least one real zero.
70. Find all the exact roots of a polynomial equation by using a combination of the theorems and techniques presented in the text.
71. Define a rational function and use algebraic methods to find its x- and y-intercepts, and any vertical, horizontal, and slant asymptotes of its graph.
72. Sketch the graph of a rational function either by algebraic analysis or by using a graphing calculator.
73. Identify the properties, domain, and range of exponential functions and sketch their graphs.
74. Identify the natural exponential function and its connection with compound interest.
75. Solve applied problems involving population growth, radioactive decay, and compound interest.
76. Recognize logarithmic functions as inverses of exponential functions.
77. State the domain and range of a logarithmic function and draw its graph.
78. Prove the properties of logarithms and use them correctly.
79. Solve exponential and logarithmic equations without calculators (when possible) and with calculators (when necessary).
80. Know and use the change-of-base formula for logarithms.
81. Using algebraic methods, solve exponential and logarithmic equations relating to applied problems, and approximate exact solutions by using a calculator.
82. Solve systems of linear and nonlinear equations by the substitution and elimination methods and by the use of a graphing calculator.
83. Compute the determinants of 2x2 and 3x3 matrices by expansion by cofactors and by row and column transformations.
84. Use a graphing calculator to compute the determinant of a small-dimensional square matrix (2x2 through 5x5).
85. Know and use Cramer’s Rule to solve “square” systems of linear equations, with and without a graphing calculator.
86. By algebraic methods, find the partial fraction decomposition of a rational function, whether the denominator is a product of distinct or repeated linear or irreducible quadratic factors.
87. State the locus definitions of a parabola, an ellipse, and a hyperbola, and derive equations for these conic sections when the axes of symmetry are horizontal or vertical.
88. Given the equation of a parabola, find its vertex, its focus, its directrix, and its axis of symmetry, and sketch the graph.
89. Find the equation of a parabola, given a minimum amount of information about its vertex, focus, directrix, focal width, and axis of symmetry.
90. Given the equation of an ellipse, find its center, foci, major and minor axes, intercepts, and eccentricity, and sketch the graph; conversely, given minimal information about these features of the graph of an ellipse, find the equation.
91. Given the equation of a hyperbola, find the asymptotes and intercepts of the graph and draw the graph.
92. Recognize and sketch the graphs of conic sections whose centers have been shifted horizontally or vertically.
93. Know the notation and terminology associated with sequences and series.
94. List the terms of a sequence defined either explicitly or recursively.
95. Expand a sum given in sigma notation.
96. Write the nth term of a sequence, given the first several terms of the sequence.
97. Identify arithmetic sequences by finding the common difference.
98. Determine any of the following for an arithmetic sequence, given any of the others: two specific terms, one term and the common difference, the sum of a finite number of terms.
99. Identify geometric sequences by finding the common ratio.
100. Determine any of the following for a geometric sequence, given any of the others: two specific terms, one term and the common ratio, the sum of a finite number of terms.
101. Find the sum of an infinite geometric sequence with a common ratio of absolute value less than one.
102. Calculate expressions involving factorial notation.
103. State the Binomial Theorem, and use it to expand small (2nd through 6th) powers of binomials.
104. Find the rth term of the expansion of a power of a binomial.
105. Understand the definition of piecewise defined functions and be able to graph such functions by hand.