Math 2111: Pre-Calculus Mathematics

Credit hours: **4 credit hours**
Prerequisites: **Placement in ACCUPLACER Grid 7 or MATH 2110 with a grade of C or better**

Course Description

Functions and their graphs are discussed with particular attention paid to polynomial, rational, trigonometric, exponential, and logarithmic functions. Determinants, matrices, complex numbers, and analytic geometry are also studied.

Course Objectives

1. Prepare students to be successful in the calculus sequence
2. Further enhance algebraic skills required for calculus
3. Combine elements of Algebra and Trigonometry to form connections between the course outcomes

Learning Outcomes

1. Utilize the complex numbers to obtain all solutions of quadratic equations, and those that are quadratic in form
2. Evaluate functions, including piecewise functions
3. Investigate the domain, range, and symmetry of functions algebraically and graphically
4. Determine the composition of functions
5. Calculate the distance between two points
6. Find the zeros of polynomials by synthetic division or long division
7. Ascertain the vertices and intercepts of functions
8. Identify any asymptotes of rational functions
9. Solve polynomial and rational inequalities and express results as unions or intersections of sets
10. Express the inverse of a relation algebraically and graphically
11. Graph exponential and logarithmic functions
12. Use the properties of logarithms to solve equations
13. Study common and natural logarithms
14. Add and subtract vectors
15. Plot complex numbers in the form a+bi as well as trigonometric form
16. Apply DeMoivre's Theorem to raise a complex number to a power, and find the nth root of a complex number
17. Solve systems of linear equations using graphing, substitution, elimination, and matrix methods
18. Perform matrix operations and determine inverses and determinants of matrices
19. Solve systems of nonlinear equations in two variables by graphing and substitution
20. Define a conic section and graph parabolas, circles, ellipses, and hyperbolas
21. Identify the foci, center, axes, asymptotes, etc. for parabolas, circles, ellipses, and hyperbolas
22. Study the polar coordinate system and plot polar curves

Course Topics

I. FUNCTIONS AND GRAPHS
    A. Domain and Range
        1. Even and Odd functions
    B. Transformations of Functions
        1. Reflections
        2. Vertical translations
        3. Horizontal translations

C. Combinations of Functions
   1. Addition/subtraction
   2. Multiplication/division
   3. Composition
D. Inverse Functions

II. POLYNOMIAL AND RATIONAL FUNCTIONS
A. Linear functions
B. Quadratic functions
C. Polynomial functions of higher degree
D. Synthetic division and zeros of polynomial functions
   1. Remainder Theorem
   2. Factor Theorem
   3. Rational zeros of polynomials
E. Complex numbers and quadratic equations
   1. Operations on complex numbers
   2. Complex conjugates
F. Rational functions and asymptotes (including slant asymptotes)
G. Polynomial and rational inequalities

III. EXPONENTIAL AND LOGARITHMIC FUNCTIONS
A. Exponential functions and their graphs
B. Logarithmic functions and their graphs
C. Natural and common logarithms
D. Properties of logarithms
E. Change of base formula
F. Exponential and logarithmic equations
G. Exponential and logarithmic models

IV. REVIEW OF TRIGONOMETRY
A. Trigonometric functions
B. Graphs of sine and cosine functions
C. Inverse trigonometric functions
D. Sum/difference, multiple-angle, power-reducing formulas
E. Trigonometric equations
F. The Law of Sines
G. The Law of Cosines

V. VECTORS AND COMPLEX NUMBERS
A. Vectors in the plane
B. Vector operations and dot product
C. Polar Coordinates
D. Trigonometric (polar) form of a complex number
E. DeMoivre's Theorem and finding complex roots

VI. MATRICES AND DETERMINANTS
A. Review of solving systems of linear equations
   1. Graphing
   2. Substitution
   3. Elimination by adding
B. Matrices and systems of linear equation
   1. Augmented matrices
   2. Gaussian and Gauss-Jordan elimination
   3. Reduced and Row-echelon form of matrices

4. Systems of equations with no, or infinitely many, solutions
C. Operations with Matrices
1. Matrix Addition
2. Matrix Multiplication
D. Inverse Matrices
E. Determinants of Matrices
F. Applications

VII. ANALYTIC GEOMETRY
A. Circles
1. Center, radius, graphs
2. Finding equations
B. Ellipses
1. Foci, vertices, graphs
2. Finding equations
C. Hyperbolas
1. Foci, vertices, graphs
2. Finding equations
D. Parabolas
1. Focus, vertex, graphs
2. Finding equations
E. Polar Coordinates
F. Graphs of Polar Equations