Course Description:

College Algebra (Mth 111) is a course designed to examine, in detail, the applied, real-world, and theoretical mathematical implications of the mathematical concept of a function. The symbolic, numerical, graphical and narrative representations of the mathematical concept of a function introduced in Mth 95 will be expanded and explored. Emphasis will be on solving problems symbolically, numerically and graphically and understanding the connections among these methods in interpreting and analyzing results. Linear, Quadratic, Polynomial, Rational, Exponential, and Logarithmic functions will be studied. A graphing calculator is required.

Mth 111 has the competencies from Mth 95 (Intermediate Algebra) as prerequisites; the course is college-transferable. Mth 111 is a 4 credit hour (quarter system) course.

Performance Based Outcomes in Mathematics

Students who successfully complete any mathematics course at COCC will be able to:

1. *Work independently to explore mathematical applications and models, and to develop algebraic/symbolic, graphical, numerical, and narrative skills in solving mathematics problems.*
2. *Work as a member of a group/team on projects or activities that are designed to explore mathematical applications and models.*
3. *Use both written and oral skills to communicate about mathematical concepts, processes, complete mathematical solutions and their implications.*
4. *Use a variety of problem solving tools including symbolic/algebraic notation, graphs, tables, and narratives to identify, analyze, and solve mathematical problems.*
5. *Develop mathematical conjectures and use examples and counterexamples to examine the validity and reasonableness of those conjectures.*
6. *Create and analyze mathematical models of real world and theoretical situations, including the implications and limitations of those models.*
7. *Use appropriate technologies to analyze and solve mathematics problems, and verify the appropriateness and reasonableness of the solution(s).*

Specifically, students who complete Math 111: College Algebra will be able to:

- model and solve applied, real-world, and theoretical mathematical problems requiring the solution of linear, quadratic, polynomial, rational, exponential, and logarithmic functions. [1, 2, 4, 5, 6]
- use a graphing calculator to create appropriate graphs that represent mathematical models, determine appropriate viewing windows and accurately interpret and draw inferences regarding the meaning, implications and limitations of the graphs. [4, 5, 6, 7]
- examine a variety of relationships stated in symbolic, graphical, or tabular form and determine which represent functions; determine what the domain and range of functions are; and draw inferences regarding the meaning, implications and limitations of the given representation of the function.
- modify and combine algebraic and graphical representations of functions and describe the relationship between the methods and functional representations.
- investigate and solve one-variable non-linear inequalities by coordinate graphing and algebraic means and explain the relation between the methods and solutions.

Mth 111 Proficiencies **NAME**

After studying, place a checkmark next to those topics you feel you understand and/or are proficient with. Place a question mark next to those topics in which you feel your skill/understanding is questionable.

A successful Mth 111 student should be able to …

Prerequisite Material

1. Solve a linear equation algebraically.
2. Solve a quadratic equation algebraically. (QF is adequate)
3. Graph a line from its equation without the aid of a graphing calculator.
4. Find the equation of a line from (a) two points, (b) slope and a point, (c) graph, (d) scatter plot (regression)
5. Graph a function using a graphing calculator and find its critical points (roots, extrema, y-intercept)
6. Use a graphing calculator to find where a function reaches a specific value. e.g. find x where f(x) = 10.
7. Apply the Rules of Exponents to simplify expressions. e.g. $(3x^2)^3 = 3^3 x^6$, $x^{-3} = 1/x^3$

Solve Equations Using the Graphing Calculator

1. Solve (a) f(t) = g(t) by the intersection method, (b) Solve f(t) = 0 by the root method, (c) Solve f(t) = k by tables.

Functions (include algebraic form, graphic form, tabular form)

1. Explain the concept of a function. i.e. What is a function? Is a relationship is a function. i.e. vertical line test
2. Understand function notation/vocabulary in algebraic, graphic and tabular sense. e.g. domain, range, f(x), f(g(x))
3. Evaluate functions with (a) a change of variable, (b) at a value, (c) with a new expression. $f(x) \rightarrow f(t)$, f(2), f(a + b)
4. Give the domain and range of a function from its algebraic, graphic or tabular form.
5. Give increasing or decreasing intervals.
6. Use appropriate notation to describe an interval. e.g. $[-1, \infty) \rightarrow -1 \leq x \leq \infty \rightarrow x \geq -1$
7. Graph piecewise functions.
8. Rewrite a piecewise graph in algebraic format.
9. Rewrite an implicit function in explicit form. i.e. $F(x,y) = 0 \rightarrow y = f(x)$.
10. Graph a function in a 'friendly' window. i.e. Find an appropriate window without relying on ZoomFit
11. Simplify the different quotient. i.e. Simplify $\frac{f(x + h) - f(x)}{h}$
12. Compute the average rate of change /avg slope. i.e. favg = $\frac{f(b) - f(a)}{b - a}$
13. Transform a function graphically. i.e. $y = f(x)$ vs. $y = \pm a\, f(b(\pm x \pm h)) \pm k$
14. Perform various operations among functions. e.g. f(x) + g(x), [f(x)][g(x)], f(g(x)), $f^2(x)$, etc.
15. Find the inverse of a function algebraically or graphically.
16. Determine if the inverse of a function is a function. i.e. Vertical/Horizontal Line test.
17. Show that $f(x) \circ f^{-1}(x) = f^{-1}(x) \circ f(x) = x$ algebraically.
18. Distinguish between $f^{-1}(x)$ vs. $[f(x)]^{-1}$

Mathematical Models

1. Identify the independent vs. the dependent variable.
2. Use a mathematical model given in an algebraic or graphic form to draw conclusions, make predictions and analyze behavior inherent in the model.

Quadratics

1. Graph a quadratic and identify the four critical points: roots, vertex and y-intercept.
2. Switch between the key quadratic forms:

   $y = ax^2 + bx + c \quad \leftrightarrow \quad y = a(x - h)^2 + k \quad \leftrightarrow \quad y = a(x - r_1)(x - r_2)$
3. Find the equation of a quadratic from:

   (a) two roots and a third point, (b) vertex and a third point, (c) three random points (regression OK)

Exponents and Exponential Equations (include algebraic form, graphic form, tabular form)

1. Analyze an exponential model in algebraic or graphic form.
   a) Analyze $P(t) = P_0e^{\pm kt}$
   b) Analyze $y = a\,b^t$, convert to a e^{kt}
2. Solve exponential equations algebraically. e.g. Solve for x: $3\,e^{mx + b} = 10$

Logarithms and Logarithmic Equations (include algebraic form, graphic form, tabular form)

1. Apply the Rules of Logarithms to simplify expressions. e.g. $\ln(4x) - \ln x = \ln 4$
2. Solve logarithmic equations algebraically. e.g. Solve for x: $\ln(mx + b)^2 = 10$

Exponential Applications

1. Solve problems involving half-life.
2. Solve problems involving exponential growth. e.g. population growth, time value of money, etc.

Modeling Applications

1. Create mathematical models based on logical reasoning and algebraic relations.
2. Create mathematical models based on regression choices.
3. Analyze mathematical models. e.g. Find the maximum population, find when a population goes extinct, etc.
4. Choose the appropriate function(s) associated with a graph.

Polynomials

1. Determine the roots and multiplicities for a polynomial in factored form. e.g. $P(x) = (x - 2)^2(x + 1)^3(x + 4)$
2. Determine if the graph of a polynomial, written in factored form, passes through (slices) or bounces off the x-axis at the roots. e.g. $P(x) = (x - 2)^2(x + 1)^3(x + 4)$
3. Write a polynomial function in factored form representing a given graph.
4. Determine the general shape of a polynomial (parabola, cubic, number of turns), written algebraically, from the degree and leading coefficient of the polynomial. e.g. $P(x) = -2x^5 + 3x^2 - x + 4$
5. Understand that irrational and complex roots occur in conjugate pairs.

Writing and Working in a Group

1. Effectively communicate mathematical concepts in writing using correct mathematical notation.
2. Work collaboratively with their peers on projects or activities to explore mathematical concepts.