MOHAWK VALLEY COMMUNITY COLLEGE

UTICA, NEW YORK

COURSE OUTLINE

MA150

PRECALCULUS

Reviewed and Revised by: Robert Bernstein 5/07

Reviewed and Found Acceptable by: Robert Bernstein 5/08

Reviewed and Revised by: Robert Bernstein – 5/09

Reviewed and Revised by: Robert Bernstein – 5/10

Reviewed and Revised by: John Swistak – 5/11

Reviewed and Found Acceptable by: John Swistak – 5/12

Reviewed and Found Acceptable by: Anna Radlowski – 5/13

Reviewed and Found Acceptable by: Anna Radlowski – 5/14

Reviewed and Revised by: Anna Radlowski – 5/15

Reviewed and Found Acceptable by: Anna Radlowski – 8/16

Reviewed and Found Acceptable by: Anna Radlowski – 8/17

Reviewed and Found Acceptable by: Anna Radlowski – 9/18

Reviewed and Revised by: Russ Penner – 10/20

**Course Outline**

Title: Precalculus

Catalog Number: MA150

Class Period: 3

Practicum Hours: 2

Credit Hours: 4

Prerequisite: An appropriate placement test result or MA125 College Algebra & Trigonometry.

Catalog Description: This course prepares students for calculus through a study of the properties and graphs of polynomial, rational, trigonometric, inverse trigonometric, exponential, and logarithmic functions. Topics include an introduction to mathematical argument and conic sections. Emphasis is placed on the function concept and the appropriate use of the language of mathematics.

**General Student Outcomes**:

1. The student will demonstrate the ability to communicate mathematical results by presenting written solutions and/or proofs to various topics within the course.

2. The student will develop well-reasoned arguments.

3. The student will demonstrate the ability to interpret and draw inferences from mathematical models such as formulas, graphs, tables, and schematics.

4. The student will demonstrate the ability to recognize the limits of mathematical and/or statistical methods.

5. The student will demonstrate an ability to solve word problems using rigorous mathematical reasoning.

6. Students will be able to work effectively within a group by demonstrating openness toward diverse points of view, drawing upon knowledge and experience of others to function as a group member, demonstrating skill in negotiating differences and working toward solutions.

**COURSE TEACHING GOALS FOR ALL TOPICS:**

**GOAL A:** Use mathematical processes to acquire and convey knowledge.

**GOAL B:** Systematically solve problems.

**SUNY Learning Outcomes**

1. The student will develop well-reasoned arguments by demonstrating an ability to write proofs.

2. The student will identify, analyze, and evaluate arguments as they occur in their own and other’s work.

3. The student will demonstrate the ability to interpret and draw inferences from mathematical models such as formulas, graphs, tables, and schematics.

4. The student will demonstrate the ability to represent mathematical information symbolically, visually, numerically, and verbally.

5. The student will demonstrate the ability to employ quantitative methods such as arithmetic, algebra, geometry, or statistics to solve problems.

6. The student will demonstrate the ability to estimate and check mathematical results for reasonableness.

**TOPIC 1: FUNCTIONS**

The function concept is the basis for the entire course. The concepts of function, domain, range, one-to-one, and inverse function are reviewed and extended. The algebra of functions is discussed. Graphing of functions is emphasized.

**Student Learning Outcomes:**

The student will:

1.1 Determine whether or not a given expression represents a function

1.2 Determine the domain and range of a function, both algebraically and graphically

1.3 Simplify a difference quotient

1.4 Use symmetry and transformations as aids in graphing functions

1.5 Add, subtract, multiply, and divide functions

1.6 Form the composition of two functions

1.7 Decide whether or not a function is one-to-one

1.8 Find the inverse of a one-to-one function

1.9 Use the graph of a one-to-one function y = f(x) to sketch the graph of its inverse

1.10 Given a graph (or equation) obtained from transformations of a basic function, write the equation (or draw the graph) of the transformed function

**TOPIC 2: ALGEBRAIC FUNCTIONS**

The following types of functions are discussed: constant, absolute value, square root, reciprocal, greatest integer, linear, quadratic, polynomial of degree greater than two, rational. The complex number system is reviewed as it relates to the zeros of polynomial functions.

**Student Learning Outcomes:**

The student will:

2.1 Determine the vertex of a parabola, given the quadratic function

2.2 Graph polynomial functions of degree greater than two

2.3 Use the Factor Theorem and Remainder Theorem

2.4 Use the Fundamental Theorem of Algebra to factor polynomial functions

2.5 Use the theorem on rational zeros and the theorem on non-real zeros

2.6 Graph rational functions, including those with an oblique asymptote

2.7 Use the Intermediate-Value Theorem and the other theorems involving polynomial functions to find the zeros of polynomial functions.

**TOPIC 3: TRANSCENDENTAL FUNCTIONS**

Exponential and logarithmic functions including their properties and inverse relationship are studied. Methods for solving exponential and logarithmic equations are discussed.

The unit circle is used to develop the circular functions as functions of real numbers. Inverse trigonometric functions and trigonometric identities are discussed. Methods for solving trigonometric equations are included.

**Student Learning Outcomes:**

The student will:

3.1 Graph exponential functions

3.2 Graph logarithmic functions

3.3 Use the graph of an exponential function to obtain the graph of a logarithmic function and vice versa

3.4 Solve exponential equations

3.5 Use properties of logarithms to solve logarithmic equations

3.6 Determine the values of the trigonometric functions in exact form for multiples of π/2, π, π/4, π/3, and π/6

3.7 Determine the period, amplitude, and phase shift for a given trigonometric function

3.8 Solve trigonometric equations

3.9 Verify trigonometric identities

3.10 Solve trigonometric equations using double angle or half angle identities

3.11 Use sum, difference, double angle, and half angle identities

3.12 Graph functions of the forms y = Asin(Bx + C)+ D and   
y = Acos(Bx + C)+ D (The Sullivan textbook uses the forms   
y = Asin(ωx – φ)+ B and y = Acos(ωx – φ)+ B)

3.13 Graph the inverse sine, inverse cosine and inverse tangent

3.14 Simplify expressions involving the inverse trigonometric functions

3.15 Determine the amplitude, period, and phase shift from a given graph of a function of the form y = Asin(Bx + C) + D or   
y = Acos(Bx + C)+ D (The Sullivan textbook uses the forms   
y = Asin (ωx – φ) + B and y = Acos(ωx – φ) + B)

3.16 Use the graphing calculator to approximate the solutions of equations involving transcendental functions

**TOPIC 4: MATHEMATICAL ARGUMENT**

The student is introduced to the definition-theorem-proof format. In particular, the necessity for precise reasoning and argument to support a claim is shown. Although it is not expected that students will become "theorem provers", the student is exposed to examples of proof, both in class and in readings.

**Student Learning Outcomes:**

The student will:

4.1 Use basic trigonometric identities to derive others

4.2 Show that a given function is/isn't one-to-one

4.3 Use the Intermediate Value Theorem as an aid in locating zeros of polynomials

4.4 Use the Rational Zero theorem to show that a polynomial has no rational zeros, or to find all rational zeros of the polynomial

4.5 Use the theory of polynomials developed in class to construct a polynomial with a given set of zeros

4.6 Verify some of the basic trigonometric identities

**TOPIC 5: CONIC SECTIONS**

The student is introduced to the locus definitions of a parabola, ellipse, and hyperbola. The properties and standard equations of these conics are discussed.

**Student Learning Outcomes:**

The student will:

5.1 Write an equation of a conic that satisfies given conditions

5.2 Find various geometric components of a conic, given its equation

5.3 Sketch the graph of a conic

5.4 Solve application problems involving conics

Teaching Guide

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Text: Precalculus (10th edition) by Jay Abramson, et. Al., Openstax, 2014

**NOTE**: Although it is essential that the student becomes proficient in the manipulative aspects of precalculus mathematics, such manipulation should not be seen by the instructor to be the only objective of the course. The student should be repeatedly exposed to the theoretical aspects of the material. Problems of the “prove” or “show that” type should be assigned and discussed.  
  
A graphing calculator is required. A specific model may be suggested by the instructor.

Chapter 1 Functions 5 hours

* 1. Functions and Function Notation
  2. Domain and Range
  3. Rates of Change and Behavior of Graphs
  4. Composition of Functions
  5. Transformation of Functions
  6. Absolute Value Functions
  7. Inverse Functions

Chapter 2 Linear Functions OMIT

2.1 Linear Functions

2.2 Graphs of Linear Functions

2.3 Modeling with Linear Functions

2.4 Fitting Linear Models to Data

Chapter 3 Polynomial and Rational Functions 12 hours

3.1 Complex Numbers

3.2 Quadratic Functions

3.3 Power Functions and Polynomial Functions

3.4 Graphs of Polynomial Functions

3.5 Dividing Polynomials

3.6 Zeros of Polynomial Functions

3.7 Rational Functions

3.8 Inverses and Radical Functions

3.9 (OMIT)

Chapter 4 Exponential and Logarithmic Functions 6 hours

4.1 Exponential Functions

4.2 Graphs of Exponential Functions

4.3 Logarithmic Functions

4.4 Graphs of Logarithmic Functions

4.5 Logarithmic Properties

4.6 Exponential and Logarithmic Equations

4.7 Exponential and Logartithmic Models

4.8 (OMIT)

Chapter 5 Trigonometric Functions 3 hours

**Note:** This Chapter is mostly review material.

5.1 Angles

5.2 Unit Circle: Sine and Cosine Functions

5.3 The Other Trigonometric Functions

5.4 Right Triangle Trigonometry

Chapter 6 Periodic Functions 5 hours

6.1 Graphs of the Sine and Cosine Functions

6.2 Graphs of the Other Trigonometric Functions

6.3 Inverse Trigonometric Functions

Chapter 7 Trigonometric Identities and Equations 6 hours

7.1 Solving Trigonometric Equations with Identities

7.2 Sum and Difference Identities

7.3 Double-Angle, Half-Angle, and Reduction Formulas

7.4 Sum-to-Product and Product-to-Sum Formulas (Optional)

7.5 Solving Trigonometric Equations

7.6 (OMIT)

Chapter 8 Further Applications of Trigonometry OMIT

Chapter 9 Systems of Equations and Inequalities OMIT

Chapter 10 Analytic Geometry 4 hours

10.1 The Ellipse

10.2 The Hyperbola

10.3 The Parabola

10.4 (OMIT)

10.5 (OMIT)

The teaching guide allows 4 additional hours for the in-class assessment of student learning. The practicum experience will be included as a portion of the final grade for the course. A two hour comprehensive final examination will also be given.

**Suggested Material content for practicum hours for MA150**

The practicum period shall be devoted to the direction and guidance of student application or development of principles, concepts, and skills in a particular physical environment. (Some samples are on file.)

Chapter 1 1 lab  
Functions

Chapter 3 4 labs  
Polynomial and Rational Functions

Chapter 4 3 labs  
Exponential Functions  
Logarithmic Functions  
Logarithmic and Exponential Equations

Chapter 5 1 labs  
Trigonometric Functions

Chapter 6 2 labs  
Graphs of Periodic Functions

Inverse Trigonometric Functions

Chapter 7 2 or 3 labs  
Trigonometric Formulas  
Trigonometric Equations

Chapter 10 1 Lab  
Conics