



## COURSE OUTLINE SPRING 2009

**Course Number**  
MAT 146

**Course Title**  
Precalculus

**Credits**  
4

**Hours:**  
**lecture/Lab/Other**  
4 Lecture

**Co- or Pre-requisite**  
**Pre-requisite: MAT 141 with a minimum C grade or equivalent or appropriate placement score on college level placement test. Credit will be given for only one of MAT 145 or MAT 146.**

**Implementation**  
**sem/year**  
Fall 2008

### **Catalog description (2006-2009 Catalog):**

A second course in the mathematics sequence leading to calculus for engineering, computer science, math, and science majors. In depth study of polynomial, rational, exponential, logarithmic, trigonometric and inverse trigonometric functions, equations, and identities; systems of equations including matrices; extensive use of graphing calculators.

### **Is course New, Revised, or Modified?**

Revised Fall 2008

### **Required texts/other materials:**

Text: Barnett, Ziegler, Byleen and Sobecki. *Precalculus: Graphs and Models*, 3<sup>rd</sup> Edition ( McGraw-Hill)

Graphing calculator required. TI-83, 84, 86, or comparable model strongly recommended. No calculator with computer algebra systems (CAS) is permitted.

**Revision date:** Fall 2008

**Course coordinator:** Daniel Rose, 609-570-3893, rosed@mccc.edu

### **Information resources:**

The library has an extensive collection of books that students may use for extra reinforcement of the course content.

### **Other learning resources:**

MathZone, and online tutorial resource, is also made available to students enrolled in the course. Tutoring is available at the Learning Center on both campuses. Both libraries have copies of the textbook.

## **Course Competencies/Goals:**

The two primary goals of this Precalculus course are to prepare students for calculus, and to develop a comprehensive understanding that functions are statements of how a change in one quantity brings about a change in another quantity. To that end, students will develop quantitative and logical skills enabling them with the ability to effectively interpret and communicate mathematical results, both in abstract and contextual settings that arise in everyday life.

### ***The student will be able to:***

- I. Demonstrate in-depth knowledge of polynomial, rational, exponential, logarithmic, trigonometric, inverse trigonometric functions, expressions, equations and identities
- II. Generate and interpret the graphs of polynomial, rational, exponential, logarithmic, trigonometric and inverse trigonometric functions
- III. Generate and apply models of events in our daily life from which predictions can be made using data and technology
- IV. Demonstrate the understanding that given certain conditions under which two or more quantities are related, optimum solutions to problems can be obtained graphically and algebraically
- V. Demonstrate the understanding that mathematics plays an important role in various fields through the ability to transfer mathematical algorithms and techniques from problems in one field to that of another
- VI. Analyze and solve word/applications problems, applying quantitative estimations when appropriate
- VII. Demonstrate proficiency in the use of graphing calculator technology

## **Course-specific General Education Knowledge Goals and Core Skills.**

### **General Education Knowledge Goals**

**Goal 2. Mathematics.** Students will use appropriate mathematical and statistical concepts and operations to interpret data and to solve problems.

**Goal 4. Technology.** Students will use computer systems or other appropriate forms of technology to achieve educational and personal goals.

### **MCCC Core Skills**

**Goal A. Written and Oral Communication in English.** Students will communicate effectively in speech and writing, and demonstrate proficiency in reading.

**Goal B. Critical Thinking and Problem-solving.** Students will use critical thinking and problem solving skills in analyzing information.

## **Units of study in detail.**

### **Unit I [Operations on Functions, Compositions, Polynomial & Rational Functions] – 4 weeks**

#### **Learning Objectives**

#### ***The student will be able to...***

- Find the sum, difference, product and quotient of two given functions, giving the domain of each (CG I, GE 2,B)
- Find the composite of two given functions and determine the domain of the composite (CG I, GE 2,B)
- Determine the values of operations on functions or the value of the composite function when given the graphs of two functions and given an input value (CG I, II, GE 2, B)
- Find two functions,  $f$  and  $g$ , such that  $f \circ g = h$  for a given function  $h$  (CG I, GE 2,B)
- Determine whether a given set of ordered pairs, given graph, or given equation corresponds to a one-to-one function (CG I,II,VII, GE 2,4,B)

- Find the inverse and its domain and range of a given one-to-one function and verify that the two functions  $f(x)$  and  $g(x)$  are inverses of each other by showing  $f(g(x)) = x$  and  $g(f(x)) = x$  (CG I,II, GE 2,4,B)
- Graph a function and its inverse on the same axes and graph the line of symmetry  $y = x$  (CG I,II,VII GE 2,4,B)
- State and apply the Division Algorithm, Remainder Theorem, Factor Theorem, Fundamental Theorem of Algebra,  $n$  Linear Factors Theorem, Rational Zeros Theorem, Imaginary Zeros Theorem, Upper and Lower Bound Rules for Real Zeros (cover this last theorem lightly) (CG I,II, GE 2,B)
- Perform algebraic long division and synthetic division of polynomials (CG I, GE 2,B)
- Evaluate a polynomial by using the remainder theorem and synthetic division (CG I, GE 2,B)
- Determine the left and right end behavior of a polynomial using the degree and leading coefficient (CG I,II,VII GE 2,B)
- Sketch the graph of a polynomial or rational function and confirm the sketch by choosing an appropriate viewing window on the graphing calculator (CG I,II,VII, GE 2,4,B)
- Find all real zeros of a polynomial or rational function and confirm the zeros by using the “root” or “zero” function on the graphing calculator (CG I,II,VII, GE 2,4,B)
- Use the maximum and minimum functions on the graphing calculator to find the local extrema of a given polynomial (CG I,II,VII, GE 2,4,B)
- Describe the behavior of the graph of a polynomial at a zero with an odd or even multiplicity (CG I,II,, GE 2,4,A, B)
- Write an equation of a polynomial having given zeros and a given degree (CG I,II, GE 2, A, B)
- Find, if possible, all the zeros and their multiplicity of a polynomial function with real coefficients and write the polynomial as a product of linear and irreducible quadratic factors over the real numbers using various methods, including the Rational Zeros Theorem (CG I,II, GE 2, A, B)
- Approximate irrational zeros for a polynomial using the bisection method for odd multiplicity zeros or a maximum or minimum approximation for even multiplicity zeros to two decimal places (CG I, II, GE 2,B)
- Find the vertical, horizontal, and/or slant/oblique asymptotes, if any, for a rational function (CG I, II, GE 2,B)
- Solve applications that result in equations which are polynomial or rational functions and interpret findings in the context of the application (CG III, VI, GE 2,A,B)
- Use graphing calculator technology to accomplish these tasks, where applicable (CG I, II, III, VI, VII, GE 2,4,B)

## **Unit II [Logarithmic and Exponential Functions] – 3 weeks**

### **Learning Objectives**

***The student will be able to...***

- Graph a given exponential function or logarithmic function, indicate its domain and range,  $x$  or  $y$  intercept, describe it as increasing or decreasing and identify any asymptotes the graph has (CG I, II, VII, GE 2,4, A,B)
- Solve exponential equations in which it is possible to convert to the same base and equate exponents (CG I, IV, GE 2,4, B)
- Simplify and evaluate logarithmic expressions (CG I, GE 2, B)
- Write logarithmic expressions in simpler form using the properties of logarithms (CG I, GE 2, A, B)
- Write a given expression as a single logarithm using the properties of logarithms (CG I, GE 2, A, B)
- Solve logarithmic equations using the properties of logarithms (CG I, IV, GE 2, 4, B)
- Use a calculator to evaluate expressions involving common and natural logarithms (CG I, VII, GE 2,4,B)

- Solve applications that result in exponential or logarithmic models such as radioactive decay, bacterial growth, compound & continuous interest, decibel level, earthquake intensity, regression, etc. (CG I,III, V, VI, GE 2,4, A,B)
- Solve exponential equations by converting to logarithmic form (CG I, IV, GE 2,4,B)
- Solve logarithmic equations by converting to exponential form (CG I, IV, GE 2,4,B)
- Use the change of base formula to find the logarithm of any number in any base  $> 0$  using base 10 or base  $e$  (CG I, VII, GE 2,4,B)
- Use graphing calculator technology to accomplish these tasks, where applicable (CG I, VII, GE 2,4,A,B)

### **Unit III [Trigonometric Functions] – 3 weeks**

#### **Learning Objectives**

***The student will be able to...***

- Display proficiency in working with positive, negative, coterminal, straight, right, acute, obtuse, complementary, quadrantal, and supplementary angles (CG I, GE 2,B)
- Convert from radian measure to degree measure and vice-versa (CG I, GE 2,B)
- Use the formula  $\theta = \frac{s}{r}$  to find the radian measure for a central angle which subtends an arc  $s$  on a circle of radius  $r$  (CG I, GE 2,B)
- Find a positive and a negative coterminal angle for a given angle in degrees and radians (CG I, GE 2,B)
- Find linear speed and angular speed in applications (CG I, VI, GE 2,A,B)
- Define the six circular or trigonometric functions in terms of the unit circle; in terms of  $a$ ,  $b$ , and  $r$ ; or in terms of the sides of a right triangle (CG I, GE 2,B)
- Find the coordinates of a given circular point (optional) (CG I, GE 2,B)
- Determine the signs of the trigonometric functions in any given quadrant (CG I,II, GE 2,B)
- Find the reference angle for a given angle (CG I, GE 2,B)
- Find the values of the six trigonometric functions for an angle  $\theta$  in standard position that has a terminal side passing through a given point  $(a,b)$  or when given the value of one of the trigonometric functions of the angle (CG I, II, GE 2,B)
- Evaluate the six trigonometric functions for a given angle in degrees or radians using a graphing calculator (CG I, VII, GE 2,4,B)
- Display proficiency in applying reciprocal and Pythagorean identities with trigonometric functions (CG I, GE 2,B)
- Solve for the missing sides and angles of a right triangle when given one other angle and a side or when given two sides (CG I, IV, GE 2,4,B)
- Solve right triangles in contextual applications (CG I, IV, VII, GE 2,4, A,B)
- Sketch the graphs of equations of the form  $y = A \sin(Bx + C) + k$  or  $y = A \cos(Bx + C) + k$ , and determine the amplitude, period, phase shift and vertical shift, as well as the intercepts, domain and range (CG I,II,VII GE 2,4, B)
- Sketch the graphs of  $y = A \tan(Bx + C)$ ,  $y = A \cot(Bx + C)$ ,  $y = A \csc(Bx + C)$ ,  $y = A \sec(Bx + C)$  and determine the period, domain, range, and intercepts of each, as well as the phase shift (CG I,II,VII GE 2,4, B)
- Determine the restrictions needed to make  $y = \sin x$ ,  $y = \cos x$  and  $y = \tan x$  one-to-one functions so the inverse trigonometric functions can be defined, and determine the domain and range for  $y = \sin^{-1} x$ ,  $y = \cos^{-1} x$ , and  $y = \tan^{-1} x$  (CG I,II,VII GE 2,4, B)
- Find the acute angle  $\theta$  when given a trigonometric function value of  $\theta$  by using inverse trigonometric functions (CG I, IV, VII, GE 2,4,B)
- Evaluate given inverse trigonometric expressions (CG I, VII, GE 2,4,B)
- Graph inverse trigonometric equations (CG I,II VII, GE 2,4, B)
- Solve applications that result in trigonometric or inverse trigonometric equations (CG I, III, V, VI, GE 2,4, A, B)
- Use graphing calculator technology to accomplish these tasks, where applicable (CG I, VII, GE 2,4,A,B)

## **Unit IV [Trigonometric Identities, Conditional Equations, Law of Sines/Cosines] – 3 weeks**

### **Learning Objectives**

***The student will be able to...***

- State and apply the basic trigonometric identities including the reciprocal, quotient, negatives, and Pythagorean identities. (CG I, GE 2,A,B)
- State and apply the sum and difference identities (CG I, GE 2,A,B)
- State and apply the cofunction identities; that is, cofunctions of complementary angles are equal (CG I, GE 2,A,B)
- State and apply the double- and half-angle identities (CG I, GE 2,A,B)
- Solve conditional trigonometric equations (CG I,IV, GE 2,A,B)
- Distinguish between trigonometric identities and conditional trigonometric equations (CG I, GE 2,A,B)
- Verify trigonometric identities by using definitions or previously verified trigonometric identities such as the reciprocal, quotient, Pythagorean, sum and difference, cofunction, double- or half-angle identities (CG I, GE 2,A,B)
- Use appropriate sum/difference identities to find exact values of trigonometric functions of given angles in radical form (CG I, GE 2,A,B)
- Solve conditional trigonometric equations by using identities to rewrite in terms of one or two trigonometric functions and factoring, or using a graphing calculator to find all solutions for  $0 \leq \theta < 2\pi$  or  $0^\circ \leq \theta < 360^\circ$  (CG I,IV, GE 2,A,B)
- Solve applications that result in trigonometric equations and utilize trigonometric identities (CG I,III,IV,VI, GE 2,A,B)
- State and apply the Laws of Sines and Cosines in standard skills and word problems (CG I,IV,VI GE 2,4, A,B)
- Use graphing calculator technology to accomplish these tasks, where applicable (CG I, III, IV, VI, VII, GE 2,4, A,B)

## **Unit V [Modeling with Systems of Equations & Additional Choice of Topic] – 2 weeks**

This last unit of the course is broken into two parts. Part one dealing with solving systems of linear equations in 2 and 3 variables is mandatory. Part two consists of one additional topic, chosen at the discretion of the instructor (please see below).

### **Part One (Mandatory)**

#### **Learning Objectives (Solving systems of linear equations in 2 or 3 variables)**

***The student will be able to...***

- Solve a system of linear equations in 2 and 3 variables by the substitution or elimination method, interpreting special cases of zero or infinite solutions (CG II, IV, GE 2, B)
- Classify a system of linear equations in 2 or 3 variables as consistent/inconsistent, dependent/independent (CG II, IV, GE 2,B)
- Solve application problems using the above methods (CG II, IV, VI, GE 2, A, B)
- Use graphing calculator technology to verify solutions to linear systems in 2 or 3 variables (without using matrices) (CG II, IV, VI, VII, GE 2, 4, A, B)

## Part Two (Choose Either Option A or Option B)

### **Option A (Linear programming) Learning Objectives**

***The student will be able to...***

- Graph systems of linear inequalities in 2 variables (CG II, IV, GE 2, B)
- Identify objective functions and constraints for simple linear programming problems and applications (CG II, IV, VI, GE 2, B)
- Finding optimization solutions to simple linear programming problems and applications (CG II, IV, VI, GE 2,A,B)

### **Option B (Solving system of linear equations using matrices & graphing calculators)**

#### **Learning Objectives**

***The student will be able to...***

- Use Gauss-Jordan elimination (by hand or by using the row-reducing capabilities of a graphing calculator) to solve linear systems of equations in 2 or 3 variables. (CG II, IV, VII, GE 2,4,B)
- Solve application problems using the above methods (CG II, IV, VI, VII, GE 2,4,A,B)

### **Evaluation of student learning:**

The tests, projects and exams will vary somewhat to allow for individual creativity and professionalism of the instructor. Incorporating group work/projects that can be used both in and out of class as part of your assessment is strongly encouraged. Giving in-class quizzes is strongly recommended. One possible plan includes a test on each of the first four units, and a comprehensive final exam covering the material in the fifth unit. **A comprehensive, cumulative final exam must be given.**

Test 1 (covering unit I)	15%
Test 2 (covering unit II)	15%
Test 3 (covering unit III)	15%
Test 4 (covering unit IV)	15%
Final Exam (covering units I-IV AND V)	25%
Homework/Quizzes/Projects	15%

### **Academic Integrity Statement:**

Mercer County Community College is committed to Academic Integrity – the honest, fair, and continuing pursuit of knowledge, free from fraud or deception. Students should never:

- Knowingly represent the work of others as their own
- Knowingly represent previously completed academic work as current
- Fabricate data to support academic work
- Use or obtain unauthorized assistance in the execution of any academic work
- Give fraudulent assistance to other students
- Unethically use technological means to gain academic advantages

Violators of the above actions will be penalized, and offenders will be reported to the Academic Integrity Committee. Please see the Student Handbook on Academic Integrity for additional details.