WINONA STATE UNIVERSITY

COLLEGE OF SCIENCE AND ENGINEERING

DEPARTMENT OF MATHEMATICS AND STATISTICS

**Course Outline – MATH 112**

**Course Title:** Applied Precalculus

**Number of Credits:** 3

**Catalog Description:** This course will help students learn both algebraic skills and problem-solving skills. Topics include the algebraic and symbolic manipulation of linear functions, quadratic functions, exponential and logarithmic functions, trigonometric functions, polynomial and rational functions, inverses and compositions of functions, transformations of functions and their graphs, and applications. In addition, the course emphasizes problem-solving skills including unit analysis; changing representations (graphical, tabular, formulaic, and verbal) of data; comparison of solutions with intuition; and analysis of various solution methods.  Meets GOAL 4. Prerequisite: MATH 050 - Intermediate Algebra or mathematics placement.

**Possible Textbooks:** To be chosen from among the following references.

* *Functions Modeling Change: A Preparation for Calculus (2nd edition)* by Connally, Hughes-Hallett, Gleason, et al., McGraw Hill (2004).
* *Functioning in the Real World: A Precalculus Experience (2nd edition)* by Gordon/Gordon/Fusaro/Siegel/Tucker, Addison-Wesley (2004).
* *Functions and Change:* *A modeling approach to college algebra (fourth edition)*  
  by Crauder, Evans and Noel (Note: The title of this text may suggest it is a college algebra text, however, this text is appropriate for the topics below.)

**Topics Covered:**

1. Review of Algebra
   1. Real Numbers
   2. Exponents and Radicals
   3. Algebraic and Rational Expressions
2. Functions, Lines, and Change
   1. Functions and Function Notation
      1. Representations of functions by words
      2. Representations of functions by graphs
      3. Representations of functions by formulas
      4. Representations of functions by tables of numbers
   2. Functions and Rate of Change
   3. Linear Functions
      1. Constant Rate of Change
      2. Formulas for Linear Functions
   4. Geometric Properties of Linear Functions
      1. Parallel Lines
      2. Perpendicular Lines
   5. Fitting Linear Functions to Data
3. Functions, Quadratics, and Concavity
   1. Functions
      1. Input and Output / Domain and Range
      2. Piecewise Defined Functions
      3. Inverse Functions
   2. Concavity and Rates of Change
   3. Quadratic Functions
4. Exponential Functions
   1. Family of Exponential Functions
   2. Comparing Exponential and Linear Functions
   3. Graphs of Exponential Functions
   4. Continuous Growth and the Number e
5. Logarithmic Functions
   1. Logarithms and their Properties
   2. Modeling with exponential functions and logarithms
      1. Logarithms and Exponential Models
      2. The Logarithmic Function
   3. Logarithmic Scales (optional)
6. Transformations of Functions and Their Graphs
   1. Vertical and Horizontal Shifts
   2. Reflections and Symmetry
   3. Vertical Stretches and Compressions
   4. Horizontal Stretches and Compressions
   5. Applications of transformations to the Family of Quadratic Functions
7. Compositions, Inverses, and Combinations of Functions
   1. Composition of Functions
   2. Inverse Functions
   3. Combinations of Functions
8. Polynomial and Rational Functions
   1. Power Functions
   2. Polynomial Functions
   3. Rational Functions
   4. Comparing Power, Exponential, and Log Functions
   5. Fitting Exponentials and Polynomials to Data (optional)
9. Additional Topics Time Permitting:
   1. Trigonometric Functions (optional)
   2. Introduction to Periodic Functions
      1. The Sine and Cosine Functions
      2. Radians
      3. Graphs of the Sine and Cosine
      4. Sinusoidal Functions
   3. Inverse Trigonometric Functions

**Name and Author of Text:** Given above

**Remarks:** a course in Applied Precalculus that prepares to succeed if they go on to MATH 140, Applied Calculus.

**Approximate Pace of Coverage:**

**Method of Instruction:** The basic method of instruction will be lecture, discussion, problem sessions, and/or group work. In addition, students will likely have access to online learning resources available from most publishers of introductory mathematics texts and have additional help available through university tutoring.

**Evaluation Procedure:** Course requirements will include homework assignments, quizzes, and exams. Students may also be required to complete outside work using online learning resources.

**Minnesota Transfer Curriculum:** *The following language should appear on each**instructor’s syllabus for the course:*

**Goal 4 under GEP:** ***Mathematics/Logical Reasoning*** – This is a General Education Program course that satisfies the Mathematics/Logical Reasoning requirement of the Minnesota Transfer Curriculum. The goal of this requirement is to increase students' knowledge about mathematical and logical modes of thinking. This will enable students to appreciate the breadth of applications of mathematics, evaluate arguments, and detect fallacious reasoning. Students will learn to apply mathematics, logic, and/or statistics to help them make decisions in their lives and careers. Minnesota's public higher education systems have agreed that developmental mathematics includes the first three years of a high school mathematics sequence through intermediate algebra.

Students will be able to:

1. Illustrate historical and contemporary applications of mathematics/logical systems.

Nearly all course topics have an application component to them, where students will need to use them to solve real-world problems. Many of these are word problems that force students to critically analyze given information and extract the important elements in order to construct algebraic expressions and equations that can then be solved. Another main focus of the course is the use of different representations of functions (graphical, tabular, symbolic, and verbal) to solve application (word/story) problems.

1. Clearly express mathematical/logical ideas in writing.

Solving word problems forces students to extract from given information (or data) the important elements that can then be used to set up equations or other representations that allow them to solve the problem. Students will be required not only to use the data to solve the problems, but will be required to explain and intepret their solution and how they used that data and why their solution is appropriate.

1. Explain what constitutes a valid mathematical/logical argument (proof).

In solving the real-world problems student develop methods of mathematical argument. This involves logically leading from a problem’s statement to its solution through a sequence of mathematically valid steps.

1. Apply higher-order problem-solving and/or modeling strategies.

In working with the different forms of information and developing solutions to problems students will see connections between various approaches. The ability to approach a fresh problem and develop new approaches is stressed.

**MnSCU Learning Outcomes:**

* Students will demonstrate the ability to illustrate historical and contemporary applications of mathematics/logical systems.
* Students will demonstrate the ability to clearly express mathematical/logical ideas in writing.
* Students will demonstrate the ability to explain what constitutes a valid mathematical/logical argument (proof).
* Students will demonstrate the ability to apply higher-order problem-solving and/or modeling strategies.

**Last Revised:** Fall 2017 by the Mathematics Subgroup