Course Title: Precalculus

Number of Credits: 4

Catalog Description: A study of topics designed to give students the skills necessary for successful completion of calculus. Equation solving, graphing, functions, and trigonometry are some of the main topics covered. Meets GOAL 4. Prerequisite: Qualifying score on the mathematics placement exam or MATH 115 - College Algebra.


Topics Covered: The overall goal of this course should be to provide students with the ability to manipulate graphs and solve equations.

A. Review Topics
   1. Natural numbers, whole numbers, integers, rational numbers, irrational numbers, real numbers, complex numbers
   2. Formal rules of algebra, exponents, radicals, polynomials, factoring,
   3. Inequalities, absolute value
   4. Functions, exponential and logarithmic functions, how to use logarithms and exponents without calculators
   5. Graphing simple functions, linear equations, quadratic equations

B. Functions
   1. Increasing and decreasing functions, transformations of functions and creating new functions, combining functions, composition of functions, one-to-one functions and their inverses
   2. Polynomial and Rational functions
   3. Modeling with functions
   4. Exponential and Logarithmic Functions

C. Trigonometry
   1. Unit circle, angle measure, radian measure
   2. Trig functions of real numbers, trig functions of angle measure
   3. Graphs of all trig functions with transformations of amplitude, phase shift, vertical shift, and time period
   4. Modeling with Sine, Cosine and Tangent functions using right triangles
   5. The laws of Sine and Cosine function
   6. Unit circle trig identities; addition, subtraction, double-angle and
   7. Inverse trig functions and solving trigonometric equations
   8. Sum-product, product-sum, half-angle identities, optional
9. Modeling Harmonic Motion, optional

D. Introduction to Polar Coordinates
   1. Plot points and convert polar to rectangular and vice-versa
   2. Graph rays, circles, spirals (optional: cardioid and roses) in polar coordinates
   3. Polar form of complex numbers
   4. Finding nth roots of complex numbers, use of DeMoivre’s theorem

E. System of linear equations of two or more variables
   1. Solve a linear system of two or more variables using matrices
   2. Understanding row operations
   3. Partial fraction decomposition of rational functions

F. Analytic Geometry (optional)
   1. Conic Sections
   2. Vectors

G. Introduction to sequences and series
   1. Understanding sequences as functions on the natural numbers
   2. Explicit and recursive sequences
   3. Properties of arithmetic and geometric sequences
   4. Finding partial sums of arithmetic and geometric series
   5. Infinite geometric series, optional

Name and Author of Text: Given above

Remarks: None

Approximate pace of coverage: 33 required sections in 14 weeks → approximately 3 to 4 sections per week. This should give enough time for review, in-class exams and discussions.

Method of Instruction: Lecture-presentation, discussion, question-answer sessions, use of calculators/computers, group work.

Evaluation Procedure: Homework, quizzes, projects, midterm exams, and a final exam.

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 which 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.

2. 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 interpret their solution and how they used that data and why their solution is appropriate.

3. 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.

4. 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 use logical reasoning by studying mathematical patterns and relationships that includes functional notation and identities.
- Students will learn the combination of functions, such as sums, products and compositions.
- Students will understand the relationships between exponential and logarithmic functions.
- Students will use mathematical models to describe real-world phenomena and to solve real-world problems - as well as understand the limitations of models in making predictions and drawing conclusions.
- Students will learn to use linear models for bivariate functions, exponential models for growth or decay, and periodic models with trigonometric functions.
- Students will learn how to organize data, communicate the essential features of the data, and interpret the data in a meaningful way.
- Students will know to express the relationships illustrated in graphical displays and tables clearly and correctly in words.
- Students will be able to express solution sets correctly with a number line graph by using interval notation and inequalities.
- Students will identify and express characteristics of the graphs of powers, polynomials, rational functions, exponential, and trigonometric functions.
- Students will identify functional characteristics including increasing/ decreasing intervals, curvature, local optima, long-term behavior.

**Last Revised:** Spring 2013 by the Mathematics Subgroup