WINONA STATE UNIVERSITY

COLLEGE OF SCIENCE AND ENGINEERING

DEPARTMENT OF MATHEMATICS AND STATISTICS

**Course Outline-MATH 117**

**Course Title:** Precalculus with Modeling

**Number of Credits**: 4

**Catalog Description:** A precalculus course with primary emphasis on introductory mathematical modeling. Topics include modeling using linear and polynomial functions, exponential growth and decay scenarios, logarithmic relationships, sinusoidal functions, and difference equations. In addition, the course includes analysis of these modeling methods. Applications will include population, and physiological models. Meets GOAL 4. Prerequisite: Qualifying score on the math placement exam, or MATH 050. Meets GOAL 4 – Mathematical/Logical Reasoning.

**Possible Textbooks:** *Precalculus: Mathematics for Calculus*, 6th Edition by Stewart, Redlin, and Watson, Thomson-Brooks/Cole (2007)

**Topics Covered:**

1. Introduction to Modeling
   1. Empirical vs. theoretical models
   2. Goals, assumptions, and limitations of models
   3. Unit analysis
2. Review Topics
   1. Natural numbers, whole numbers, integers, rational numbers, irrational numbers
   2. Formal rules of algebra, exponents, radicals, polynomials, factoring
   3. Inequalities, absolute value
3. Functions
   1. The idea of a function
   2. One-to-one functions and their inverses
   3. Transformations of functions, combining functions, composition of functions
4. Polynomial and rational functions
   1. Basic properties of linear, polynomial, and rational functions
   2. Modeling with polynomial functions
5. Validating models
   1. Dealing with measurement error
   2. Accept, improve, or reject a model?
6. Exponential and logarithmic Functions
   1. Basic properties of exponential and logarithmic functions
   2. Modeling with exponential and logarithmic functions
7. Trigonometric Functions
   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
   4. Modeling with trigonometric functions
8. More Advanced Modeling
   1. Modeling with difference equations
   2. Modeling with differential equations using Euler's Method
   3. Modeling with discrete-time Markov chains
   4. Modeling dynamical systems shift, and time period

**Name and Author of Text:** Possible textbooks include:

* *Functions Modeling Change*, current edition by Deborah Hughes-Hallett, et al.
* *Contemporary Precalculus through Applications: Functions, Data Analysis, and Matrices*, current edition, by Gloria Barrett et al.
* *Functioning in the Real World: A Precalculus Experience*, current edition, by Sheldon P. Gordon et al.
* *Precalculus: A View of the World around Us*, current edition, by David Wells and Lynn Tilson

Additional Resources

* *Biomath: Problem Solving for Biology Students*, current edition, by Robert W. Keck and Richard R. Patterson
* *Earth Algebra: College Algebra with Applications to Environmental Issues*, current edition, by Christopher Schaufele, et al.

**Remarks:** None

**Approximate pace of coverage**: A substantial portion of time will be spent on, and a significant part of the student's final grade will depend on, modeling important real-world phenomena. Students will be required to solve realistic problems using technology.

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

**Evaluation Procedure:** Students will be assessed on their class participation, and their performance on in-class activities, case studies, homework problems, quizzes, midterm exams, and a final exam, as set by the instructor.

**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.

*Rationale for Goal Area 4:* Mathematical models are increasingly being used in a wide variety of fields. Currently at WSU, a student must work through at least four MATH courses to take a course on modeling, even though many models can be understood, and used intelligently, with much less preparation. This course will introduce students to the unique perspective given by mathematical models, with only minimal prerequisites, and give them practice using such models to reason about important issues in the real world.

**How Student Competencies will be Developed by**

**Learning Activities in MATH 117**

| **Goal 4 Competencies: Students will be able to…** | **Learning Opportunity** | **Assessment and Evaluation** |
| --- | --- | --- |
| **Illustrate historical and contemporary applications of mathematical/logical systems** | Ever since, in Pope's words, "God said, Let Newton be! and there was light", mathematical models have had the most profound impact on history. They have helped us conquer disease, and have taken us to the moon, uniquely among all civilizations. It would be impossible NOT to illustrate profound applications of modeling techniques in a modeling course. | Students will be required to create and modify simple mathematical models for important phenomena; necessarily they will, in Newton's words, "Stand upon the shoulders of giants," and they will be graded on their efforts. |
| **Clearly express mathematical/logical ideas in writing** | The distinction between pure math and mathematical modeling is precisely that models are supposed to represent and explain something. Correctly interpret-ing what a model does, and does not, say will be a major emphasis in the course. | As part of the assessments on modeling, students will be graded on how well they explain their model, including the underlying assumptions, and the limitations of the model. |
| **Explain what constitutes a valid mathematical/logical argument (proof);** | The proofs behind even the simplest mathematical models are well beyond the level of this class. However, students will be taught how to give a solid argument that a given model is, or is not, a useful representation of reality. | Students will be required to create, modify, and compare models; they will also be required to give a solid logical argument justifying the choices they made, and the structure they derived. |
| **Apply higher-order problem-solving and/or modeling strategies** | To create or modify a model, students must necessarily abstract the mathematical essence of a phenomenon. To critique or validate that model, they must make predictions and test those against data. This is all high-order problem solving. | Students will be assessed here concurrently with being assessed in the other three areas. |

**MnSCU LMearning Outcomes:**

**Last Revised:** Spring 2016 by the Mathematics Subgroup