WINONA STATE UNIVERSITY

COLLEGE OF SCIENCE AND ENGINEERING

DEPARTMENT OF MATHEMATICS AND STATISTICS

**Course Outline-MATH 140**

**Course Title:** Applied Calculus

**Number of Credits**: 3

**Catalog Description:** An intuitive approach to calculus for students in business, management, or the social sciences. Emphasis throughout is to enhance students’ understanding of how mathematics is used in real-world applications.  Meets GOAL 4. Prerequisite: Qualifying score on the mathematics placement exam, MATH 112 - Modeling with Functions, MATH 115 - College Algebra, or MATH 120 - Precalculus.

**Note:** *Effective Spring 2013* - An intuitive approach to calculus.  Emphasis throughout is to enhance students’ understanding of how mathematics is used in real-world applications.  Prerequisite: Qualifying score on the mathematics placement exam, MATH 112 - Modeling with Functions, MATH 115 - College Algebra, or MATH 120 - Precalculus.

**Possible Textbooks:** Applied Calculus, by Hughes-Hallett (4th edition)

**Topics Covered:**

1. Interpretation and Application of Pre-calculus
   1. Functions and their meaning
   2. Properties of graphs
   3. Average rates of change
   4. Composition of functions
   5. Periodic functions (optional)
   6. Business Applications:
      1. Cost and Revenue
      2. Supply and Demand
      3. Continuously Compounded Interest
2. Differentiation:
   1. Instantaneous rate of change
   2. Tangent line to the curve
   3. Second derivative
   4. Using a table of data to approximate the derivative
   5. How derivatives affect the shape of a graph
   6. Derivatives of polynomial, exponential, and logarithmic functions
   7. Derivatives of periodic functions (optional)
3. The Product and Quotient Rules
   1. The Chain Rule
   2. Local linear approximations
   3. Maxima, Minima, and Inflection Points
   4. Business applications:
      1. Marginal Cost and Marginal Revenue
      2. Maximizing Profit
4. Integration:
   1. Distances and accumulated change
   2. Areas
   3. The definite integral
   4. Using a table of data to approximate the integral
   5. The Fundamental Theorem of Calculus
   6. Anti-derivatives
   7. The Substitution Rule
   8. Average value
   9. Business applications:
      1. Economic surpluses
      2. Values of continuous income streams

**Listing of Sections to be Covered (Applied Calc, 4th edition, by Hughes-Hallet):**

* **Chapter 1:** 1-9, with 10 optional
* **Chapter 2:** 1-5.
* **Chapter 3:** 1-4, with 5 optional.
* **Chapter 4:** 1-4, with 5 and 6 optional.
* **Chapter 5:** 1-5.
* **Chapter 6:** 1-3.
* **Chapter 7:** 1-3, with 4 optional.

**Remarks:** None.

**Approximate pace of coverage:**

33 required sections in 14 weeks 🡪 approximately 2.4 sections per week.

**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.

Mathematical modeling and solving real-world problems is the primary emphasis of this course.  Students learn to find, for example, the price of the tickets which maximizes revenue, how much sales needed to maximize the profit, how much money should be spending on advertising to guarantee maximum sales, what is the time when the concentration of a drug in the blood is maximum and what is the maximum concentration, how to minimize the energy needed to perform a certain job with maximum efficiency, what is the radius of the trachea when a person coughs with a maximum thrust, what should be the shape of a can to minimize the cost of the material use, how to reach a ship in the least amount of time in the middle of the ocean when it calls for help, etc., etc. -- the list is long and strong.  All these problems use the knowledge of many functions like linear functions, polynomial functions, exponential functions, logarithm functions and some trig functions; and reasoning and understanding of the problem, limitations of the models, drawing a recent diagram, introducing the variables and notations, making predictions, knowing how to take derivatives and deriving conclusions.

Modeling and solving real-world problems are also included in this course via the process of anti-derivative, where students are required to find area, average value of a certain value of a certain function which modeled the changes in price, demand or cost, find consumers and producers’ surplus, find present value or a future value of an estate or a deal in the process of negotiation, finding population of a certain country knowing the relative birth rate, growth rate and death rates etc.

1. Clearly express mathematical/logical ideas in writing.

Students need to organize data; learn to read, understand and interpret essential features of the data in this course form the beginning to the end of the course in at least three different ways.  First one is from the tables, second one is from the formula of the functions modeling the scenario and third from the graphs that presents the scenario.  Without being able to organize, communicate and interpret a data students will not survive in this course.

The required efficiency in language skill is extremely high in this course as all students will have to write their answers, interpretations with units in grammatically correct sentences in terms of finance and economics for all the problems they do whether the problems deal with elementary functions, derivatives or anti-derivatives.

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

Students will use technology and mathematical techniques to extract correct information from tables, graphs, and formulas.  First they need to understand the story, model with a function, then, use appropriate techniques to analyze the function and finally they extract the meaning information to make a prediction for the story. At every step of this process students will need to explain the logical validity of their arguments.

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

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**MnSCU Learning Outcomes:**

* Students will mathematically model and solve real-world problems.
* Students will read, understand, and interpret data given by tables, formulas, and graphs.
* Students will use technology and mathematical techniques to extract correct information from tables, graphs, and formulas
* Students will use the knowledge of many functions to reason through problems, understand the limitations of the models, and derive conclusions.

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