Course Outline – MATH 212

Course Title: Calculus I

Number of Credits: 4

Catalog Description: Differential and integral calculus of functions of a single variable. Two semesters in sequence. Meets GOAL 4. Prerequisite: Qualifying score on the mathematics placement exam or MATH 120 - Precalculus.

Possible Textbooks: Calculus: Early Transcendentals, by James Stewart (7th edition)

Topics Covered:

A. Limits and Derivatives:
   1. The Tangent and Velocity Problems
   2. The Limit of a Function
   3. Calculating Limits Using the Limit Laws
   4. The Precise Definition of a Limit
   5. Continuity
   6. Limits at Infinity; Horizontal Asymptotes
   7. Derivatives and Rates of Change
   8. The Derivative as a Function

B. Differentiation Rules:
   1. Derivatives of Polynomials and Exponential Functions
   2. The Product and Quotient Rules
   3. Derivatives of Trigonometric Functions
   4. The Chain Rule
   5. Implicit Differentiation
   6. Derivatives of Logarithmic Functions
   7. Rates of Change in the Natural and Social Sciences (optional)
   8. Exponential Growth and Decay (optional)
   9. Related Rates
   10. Linear Approximation and Differentials
   11. Hyperbolic Functions (optional)

C. Applications of Differentiation
   1. Maximum and Minimum Values
   2. The Mean Value Theorem
   3. How Derivatives Affect the Shape of a Graph
   4. Indeterminant Forms and L'Hospital's Rule
   5. Summary of Curve Sketching
6. Graphing with Calculus and Calculators
7. Optimization Problems
8. Newton’s Method (optional)
9. Antiderivatives

D. Integrals:
   1. Areas and Distances
   2. The Definite Integral
   3. The Fundamental Theorem of Calculus
   4. Indefinite Integrals and the Net Change Theorem
   5. The Substitution Rule

E. Applications of Integration:
   1. Areas between Curves
   2. Volumes by Washers (optional)
   3. Volumes by Cylindrical Shells (optional)

F. Techniques of Integration:
   1. Integration by Parts (optional)

Listing of Sections to be Covered (Calculus: ET, 7th edition, by James Stewart):
- Chapter 3: 1-6, 9, 10, with 7, 8, and 11 optional.
- Chapter 4: 1-7, 9, with 8 optional.
- Chapter 5: 1-5.
- Chapter 7: 1.
- Chapter 6: 1, with 2 and 3 optional.

Remarks:
- Cover or test on all of Chapter 1, which is review, but this is not part of the official syllabus; it is prerequisite material from Precalculus.
- Some applications to the real world should be covered in the class, whether from 3.7 or 3.8 or some other source (such as projects). We are not mandating coverage of 3.7 or 3.8, but rather applications of Calculus in general.
- Though it is no longer required, we encourage instructors to utilize ALEKS or some other comparable system which tests students on their proficiency in prerequisite material and allows them to improve their skills during the first four weeks of the semester.

Approximate pace of coverage:
31 required sections in 14 weeks → approximately 2.2 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.

   Each course in the Calculus sequence contains numerous applications to the physical sciences and to the field of finance. It is, in fact, the “language” in which many of the core ideas of those disciplines are expressed. Some examples of the types of applications covered are: predicting the spread of an epidemic; calculating the tax on a plot of land; designing a high-speed parachute relating study time to final grade; measuring the density of an object.

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).

   The development of the main concepts of limit, differentiation, and integral involve processes which unfold subject to the rules of mathematical logic.

   In addition, solving the real-world problems requires students to 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 demonstrate the ability to determine the existence and the value of the limit of a function.
- Students will demonstrate the ability to find derivatives of a function.
- Students will demonstrate the ability to describe the monotonicity of functions and to find absolute and local extrema of functions.
- Students will demonstrate the ability to find and use antiderivatives for areas between functions and for volumes of solids of revolution.

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