MISSOURI WESTERN STATE UNIVERSITY

COLLEGE OF SCIENCE AND HEALTH

DEPARTMENT OF COMPUTER SCIENCE, MATHEMATICS, AND PHYSICS

COURSE NUMBER: MAT 167

COURSE NAME: Calculus with Analytic Geometry I

COURSE DESCRIPTION:

The first of three sequenced courses in calculus. Includes the study of limits and continuity of real functions, the derivative and its applications, the integral, and the differentiation and integration of trigonometric, exponential, and logarithmic functions.
5 credit hours. Fall, Spring.

PREREQUISITE:

ACT math score of 25 or higher or a grade of C or higher in MAT 116 and MAT 119.

TEXT: One of the following texts will be used:

Active Calculus – Single Variable (2018 Edition), ISBN 978-1724458322
Available free online at http://activecalculus.org

Calculus-w/Access (Looseleaf), Larson, Edition 10th 14, Cengage L,
ISBN 9781305718661

Calculus-Enhanced.Webassign…MULTI Term, Cengage, Edition 13, Cengage L,
ISBN 9781285858265

TECHNOLOGY:

A computer algebra system will be used for some problem exploration, enhanced conceptual understanding, and to engage students as active participants in the learning process.

COURSE OBJECTIVES:

This course is intended to satisfy the general studies mathematics requirement for a baccalaureate degree. It is also designed to provide students with understanding and proficiency sufficient to enable successful students to pursue further study in mathematics and in disciplines which rely upon understanding of and/or proficiency in the calculus. In order to meet this major goal, students will learn how to:

1. Compute limits of algebraic and selected transcendental functions.

2. Utilize the definition of the derivative to derive and prove mathematical statements.

3. Find derivatives of algebraic, trigonometric, exponential, and logarithmic functions.

4. Compute definite and indefinite integrals of algebraic, trigonometric, exponential, and logarithmic functions.

5. Apply numerical methods to approximate areas bounded by continuous functions.

6. Identify and use interpretations of the derivative to solve problems such as curve sketching and maximum and minimum applications.

7. Utilize the Riemann Sum to motivate the use of the definite integral to solve problems.

8. Utilize a computer algebra system to investigate finite and infinite symbolic limits and graph, differentiate, and analyze algebraic and transcendental functions.

9. Utilize mathematical language and symbolism to communicate ideas and represent relationships.

10. Interact verbally with others to clarify and extend understanding of mathematical situations.

11. Interact in a scientific computing environment in an ethical and legal manner.

STUDENT COMPETENCIES:

In order to meet the above objectives, successful students will:

1. Demonstrate understanding of the function as a unifying concept throughout mathematics by utilizing functional notation and the algebraic properties of functions in appropriate situations.

2. Construct algebraic relationships involving two or more variables using properties of geometric figures.

3. Solve optimization problems by identifying and using interpretations of the derivative.

4. Use a symbolic differentiation utility to find the derivative of a function, use the utility to graph the function and its derivative, and describe the behavior of the function.

5. Compute areas of plane figures by using interpretations of the integral.

6. Apply the definition of the limit and limit theorems to evaluate the limit of real functions.

7. Build mathematical models for real world situations such as the velocity and acceleration of moving objects, determine minimum distance, and find maximum volume.

8. Utilize mathematical language and symbolism to communicate ideas and represent relationships.

9. Utilize the computer to obtain solutions to numerical approximation problems.

10. Solve problems involving related rates.

11. Draw the graph of a function using information obtained by computing the first and second derivative of the function.

12. Approximate function values by using the differential.

13. Compute the Riemann Sum of a given function.

14. Given a one-to-one function, find the derivative of its inverse function.

15. Solve exponential growth and decay problems.

16 Utilize the Fundamental Theorem of Calculus to evaluate the definite integral.

17. Define the real number *e*.

18. When given an integration problem, choose and use appropriate techniques of integration.

19. Compute the derivative of the composition of two differentiable functions

20. Compute the derivative of a function defined implicitly.

21. Integrate using substitution.

22. Integrate by parts.

COURSE OUTLINE:

I. Understanding the Derivative

A. Measuring Velocity
B. The Notion of a Limit
C. The Derivative at a Point
D. The Derivative as a Function
E. The Second Derivative
F. Limits, Continuity, and Differentiability
G. The Tangent Line Approximation

II. Computing Derivatives

A. Basic Differentiation Rules and Rates of Change
B. The Product and Quotient Rules and Higher-Order Derivatives
C. The Chain Rule
D. Derivatives of Inverse Functions (Derivatives of exponential and logarithmic functions)
E. Implicit Differentiation
F. Related Rates

III. Using Derivatives

A. Extrema on an Interval
B. Increasing and Decreasing Functions and the First Derivative Test
C. Concavity and the Second Derivative
D. A Summary of Curve Sketching
E. Optimization Problems

IV. Integration

A. Antiderivatives and Indefinite Integrals
B. Area
C. Riemann Sums and Definite Integrals
D. The Fundamental Theorem of Calculus
E. Integration by Substitution
F. Integration by Parts

GENERAL EDUCATION GOALS AND COMPETENCIES:

As noted above, this course is intended to satisfy the general studies mathematics requirement for a baccalaureate degree at Missouri Western State University. Specifically, upon successful completion of this course, students will have demonstrated the ability to think critically and reason analytically and will have developed an understanding of fundamental mathematical concepts and their applications.

Furthermore, upon successful completion of this course, the following state-level goals and competencies will have been met:

I. Skills Areas
   a. Communicating
      Students will demonstrate the ability to…
      6. Use mathematical and statistical models, standard quantitative symbols and various graphical tactics to present information with clarity, accuracy and precision.
   b. Higher-Order Thinking
      Students will demonstrate the ability to…
      1. Recognize the problematic elements of presentations of information and argument and to formulate diagnostic questions for resolving issues and solving problems.
      2. Use linguistic, mathematical or other symbolic approaches to describe problems, identify alternative solutions, and make reasoned choices among those solutions.
      3. Analyze and synthesize information from a variety of sources and apply the results to resolving complex situations and problems.
      4. Defend conclusions using relevant evidence and reasoned arguments.
      5. Reflect on and evaluate their critical-thinking processes.

II. Knowledge Areas
   c. Mathematics
      Students will demonstrate the ability to…
      1. Describe contributions to society from the discipline of mathematics.
      2. Recognize and use connections within mathematics and between mathematics and other disciplines.
      3. Read, interpret, analyze and synthesize quantitative data (e.g., graphs, tables, statistics, survey data) and make reasoned estimates.
      4. Formulate and use generalizations based upon pattern recognition.
      5. Apply and use mathematical models (e.g., algebraic, geometric, statistical) to solve problems.