MAC2311 Course Outline

Calculus I with Analytical Geometry .....(4) (P)

Description: This is the first semester in a three semester calculus sequence. This course includes the study of limits and continuity; derivatives for functions of one-variable including polynomial, rational, algebraic, piecewise-defined, logarithmic, exponential, and trigonometric functions; applications of derivatives; introduction to integration including the Fundamental Theorem of Calculus; and approximating techniques for derivatives and integrals.

General Education Learning Outcome: The primary General Education Learning Outcome (GELO) for this course is Quantitative Reasoning, which is to understand and apply mathematical concepts and reasoning, and analyze and interpret various types of data. The GELO will be assessed through targeted questions on either the comprehensive final or an outside assignment.

Prerequisite: MAC1114 and MAC1140 both with a "C" or better, OR MAC1147 with a "C" or better, OR the equivalent.

Rationale: In an increasingly complex world, mathematical thinking, understanding, and skill are more important than ever. Calculus will provide the students with the necessary tools to understand and formulate advanced mathematical concepts and an awareness of their relationship to complex problems. Students wishing to major in the sciences, engineering, or medicine are required to have a working knowledge of the calculus and its applications.

Impact Assessment: *Calculus I* provides students with skills for proficiency in one-variable differential and integral calculus and a conceptual understanding of those topics. The course applies toward the General Education mathematics requirement area A for an Associate of Arts degree. MAC2311 is a prerequisite for MAC 2312 and is required for many degrees in mathematics and the sciences.

Broad Course Objectives: This course supports the following goals of the Math Department:

- Engage students in sound mathematical thinking and reasoning. This should include students finding patterns, generalizing, and asking/answering relevant questions.
- Provide a setting that prepares students to read and learn mathematics on their own.
- Explore multiple representations of topics including graphical, symbolic, numerical, oral, and written. Encourage students to make connections among the various representations to gain a richer, more flexible understanding of each concept.
- Analyze the structure of real-world problems and plan solution strategies. Solve the problems using appropriate tools.
- Develop a mathematical vocabulary by expressing mathematical ideas orally and in writing.
- Enhance and reinforce the student's understanding of concepts through the use of technology when appropriate.

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As a result of successfully completing MAC2311, students should be able to demonstrate the following:

- Analyze/interpret quantitative data verbally, graphically, symbolically and numerically.
- Communicate quantitative data verbally, graphically, symbolically and numerically.
- Appropriately integrate technology into mathematical processes.
- Use mathematical concepts in problem-solving through integration of new material and modeling.

Topical Outline with Specific Course Objectives:

I. *Review of Functions*

A. Recognize algebraic and transcendental functions in various forms.

B. Understand and use function notation in tabular, graphic, algebraic, and applied settings.

C. Understand the relationship between inverse functions.

II. *Limits and Continuity*

A. Find limits algebraically, graphically, and numerically.

B. Identify and find indeterminate limits, when they exist, using appropriate tools, e.g. *L'Hopital's Rule*.

C. Use limits to describe asymptotic behavior.

D. Determine the continuity of functions algebraically and graphically.

E. Test the hypothesis and, where appropriate, apply the conclusion of the *Intermediate Value Theorem* for a function on a given interval.

III. *The Derivative*

A. Define, discuss, and interpret the concept of the derivative algebraically, verbally, numerically, and graphically.

B. Find the derivative of a function using differentiation rules.

C. Apply the theorem relating the derivatives of inverse functions.

D. Identify the major characteristics of graphs and relate them to first and second derivatives.

E. Find the differential of a function and use it to find a tangent line approximation to the function.

F. Apply Newton's method to solve equations.

G. Model related rates, optimization, and motion problems using the language of calculus. Find and discuss solutions.

H. Apply approximating techniques for derivatives.

I. Test the hypothesis and, where appropriate, apply the conclusion of the *Mean Value Theorem* for a function on a given interval.

IV. The Integral

A. Demonstrate an understanding of the concept of the definite integral and describe the difference between the definite and indefinite integral.

B. Find the indefinite integral of a function using antidifferentiation rules.

C. Find and interpret the definite integral numerically, algebraically, and graphically.

D. State and apply the *Fundamental Theorem of Calculus*.

E. Use definite integrals to find areas.

F. Apply integrals to functions describing rectilinear motion, displacement, and distance traveled.

G. Apply approximating techniques for integrals.

Evaluation: Each instructor will determine the specific criteria for the final course grade. These criteria will be delineated in the first day handout provided to each student. Each instructor will give a comprehensive final exam during the assigned final exam period.

Commonality: All instructors will use the same textbook and cover all topics in the topical outline. A computer lab with mathematical software is provided to facilitate collaboration and the use of technology. A graphing calculator will be required for this course. Either the TI-83 or the TI-84 line of calculators is recommended; any other graphing calculator will need to be approved by the instructor.