

**J. Sargeant Reynolds Community College  
Course Content Summary**

**Course Prefix and Number:** MTH 263

**Credits:** 4

**Course Title:** Calculus I

**Course Description:** Presents concepts of limits, derivatives, differentiation of various types of functions and use of differentiation rules, application of differentiation, antiderivatives, and integrals. This course replaces MTH 173 or MTH 175 or MTH 273 and is the first course in a three-course sequence. Prerequisite: Placement into MTH 263 or completion of MTH 167 or MTH 161/162 or equivalent with a grade of C or better. Lecture 4 hours per week.

**General Course Purpose:** Prepares students for further study in calculus with analytic geometry by providing them with the necessary competencies in finding limits, differentiation, and integration. Designed for mathematical, physical, and engineering science programs and students intending to pursue an undergraduate degree in engineering, mathematics, statistics, computer science, or physical sciences.

**Course Prerequisites and Co-requisites:**

Prerequisite: Placement into MTH 263 or completion of MTH 167 or MTH 161/162 or equivalent with a grade of C or better

**Student Learning Outcomes:**

Upon completing the course, the student will be able to

1. (Limits)

- Differentiate between the limit and the value of a function at a point;
- Find the limit of a function by numerical, graphical, and analytic methods;
- Apply limit laws;
- Calculate one-sided limit of a function;
- Prove the existence of a limit using precise definition of the limit;
- Determine the continuity of a function;
- Calculate vertical and horizontal asymptotes using limits;

2. (Derivatives and Differentiation Rules)

- Define derivatives and rates of change;
- Compute derivatives of basic functions using the definition of the derivative;
- Differentiate polynomial, rational, radical, exponential, and logarithmic functions;
- Find equation of a tangent line using derivative;
- Differentiate trigonometric functions;
- Apply product, quotient, chain rules;
- Apply implicit differentiation and find derivatives of inverse trigonometric functions;
- Apply concept of rates of change to natural and social sciences;
- Apply the concept of related rates;
- Define hyperbolic functions and their derivatives;
- Find linear approximation of a function at a given point;

3. (Applications of Differentiation)

- Calculate local and absolute maximum and minimum values of a function;
- Apply Rolle's Theorem and Mean Value Theorem to study properties of a function;
- Find critical points and intervals of increasing and decreasing values of a function;
- Find points of inflection and intervals of different concavities;
- Sketch a curve for a given function;
- Apply rules of differentiation to solve optimization problems;
- Find antiderivatives for basic functions using knowledge of derivatives;

4. (Integrals)

- Relate areas to definite integrals using sigma notation, Riemann sums, and limits (L'Hopital's Rule is in Calculus II but may be used for instructional purposes here);
- Apply Fundamental Theorem of Calculus to find definite integrals and derivatives;
- Find indefinite integrals of polynomials and basic trigonometric and exponential function;
- Apply Net Change Theorem;
- Perform integration using substitution rule;
- Find areas between curves; and
- Find average value of a function.

**Major Topics to Be Included:**

- Limits
- Derivatives and Differentiation Rules
- Applications of Differentiation
- Integrals

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