

MA 113 CALCULUS I (UK Course) (4 credit hours)

Official Course Description	A course in one-variable calculus, including topics from analytic geometry. Derivatives and integrals of elementary functions (including the trigonometric functions) with applications. Lecture, three hours; recitation, two hours per week. Students may not receive credit for MA 113 and MA 137. Pre-requisite: Math ACT of 27 or above, or math SAT of 620 or above, or a grade of C or better in MA 109 and in MA 112, or a grade of C or better in MA 110, or appropriate score on math placement test, or consent of the department. Students who enroll in MA 113 based on their test scores should have completed a year of pre-calculus study in high school that includes the study of the trigonometric function. Note: Math placement test recommended.
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OFFICIAL COURSE COMPETENCIES/OBJECTIVES (Approved Fall 2017)

Upon completion of this course, the student can:

1. Approximate limits graphically and numerically and evaluate limits analytically.
2. Evaluate infinite limits, limits at infinity, and limits of indeterminate form including the use of L'Hospital's Rule.
3. Determine whether a function is continuous using the definition of continuity.
4. Define the derivative of a function and evaluate the derivative using the definition.
5. Determine the derivative of a function using differentiation rules for algebraic, trigonometric and transcendental functions.
6. Use product rule, quotient rule, and chain rule techniques to determine derivatives of functions.
7. Write the equation of a line tangent to a curve at a given point using derivatives.
8. Use calculus to sketch graphs of functions.
9. Determine derivatives using implicit differentiation.
10. Define the integral of a function and evaluate using the definition of integration.
11. Find indefinite and definite integrals of a function using integration rules for algebraic, trigonometric and transcendental functions.
12. Use substitution techniques to determine the definite and indefinite integrals of functions.
13. Analyze information to develop models for solving application problems involving related rates, optimization, area under curves and velocity/acceleration.

OFFICIAL COURSE OUTLINE (Approved Fall 2017)

- I. Functions
 - A. Review
 1. Composition
 2. Inverses
 3. Trigonometric Functions
 - B. Exponential Functions
 1. Definition
 - a. Natural Exponential
 - b. General Exponential
 2. Properties
 3. Graphs
 - C. Logarithmic Functions
 1. Definition
 - a. Natural Logarithm
 - b. General Logarithm
 2. Properties
 3. Graphs
 - D. Inverse Trig Functions
 1. Definitions
 2. Properties
 3. Graphs
- II. Limits of a Function
 - A. Definition
 - B. Left and Right Handed Limits
 - C. Graphical Limits
 - D. Algebraic Limits

E. Trigonometric Limits

F. Infinite Limits

G. Limits at Infinity

H. Indeterminate Forms $\frac{0}{0}, \frac{\infty}{\infty}, \infty - \infty, 0 \times \infty, 0^0, \infty^0, 1^\infty$

I. L'Hospital's Rule

J. Squeeze Theorem

K. Continuity

1. Definition

2. Intermediate Value Theorem

III. Derivatives

A. Definition

B. Differentiation Formulas

1. Functions

a) Polynomials

b) Exponential

c) Logarithmic

d) Trigonometric

e) Inverse Trig

2. Power Rule

3. Product Rule

4. Quotient Rule

5. Chain Rule

C. Higher Order Derivatives

D. Implicit Differentiation

E. Logarithmic Differentiation

IV. Applications of Derivatives

A. Tangent Lines

B. Rolle's Theorem

C. Mean Value Theorem

D. Rates of Change

E. Related Rates

F. Linear Approximations and Differentials

G. Optimization

V. Graphing with Calculus

A. Increasing and Decreasing Functions

B. Relative Extrema

C. Concavity

D. Inflection Points

E. Asymptotes

1. Vertical

2. Horizontal

3. Oblique

F. Curve Sketching

VI. Integration

A. Riemann Sums

B. Antiderivatives

C. Fundamental Theorem of Calculus

D. Definite Integrals

E. Indefinite Integrals

F. Substitution Integrals

VII. Applications of Integrals

A. Area Under a Curve

B. Net Change

C. Velocity & Acceleration

GENERAL EDUCATION COMPETENCIES

- A. Knowledge of human cultures and the physical and natural worlds through study in the sciences and mathematics, social sciences, humanities, histories, languages, and the arts.
- B. Intellectual and practical skills, including
 - inquiry and analysis
 - critical and creative thinking
 - written and oral communication
 - quantitative literacy
 - information literacy
 - teamwork and problem solving
- C. Personal and social responsibility, including
 - civic knowledge and engagement (local and global)
 - intercultural knowledge and competence
 - ethical reasoning and action
 - foundations and skills for lifelong learning
- D. Integrative and applied learning, including synthesis and advanced accomplishment across general and specialized skills.

STUDENT LEARNING OUTCOMES FOR QUANTITATIVE REASONING (Approved Fall 2017)

In MA 113, students will learn to:

1. Interpret information presented in mathematical and/or statistical forms by (Gen Ed Comp B):
 - Approximating limits graphically and numerically and evaluating limits analytically.
 - Defining the derivative of a function and evaluating the derivative using the definition.
 - Defining the integral of a function and evaluating using the definition of integration.
2. Illustrate and communicate mathematical and/or statistical information symbolically, visually, and/or numerically by (Gen Ed Comp A, B, C):
 - Determining whether a function is continuous using the definition of continuity.
 - Using calculus to sketch graphs of functions.
3. Determine when computations are needed and execute the appropriate computations by (Gen Ed Comp A, B):
 - Evaluating infinite limits, limits at infinity, and limits of indeterminate form including the use of L'Hospital's Rule.
 - Determining the derivative of a function using differentiation rules for algebraic, trigonometric and transcendental functions.
 - Using product rule, quotient rule, and chain rule techniques to determine derivatives of functions.
 - Determining derivatives using implicit differentiation.
 - Finding indefinite and definite integrals of a function using integration rules for algebraic, trigonometric and transcendental functions.
 - Using substitution techniques to determine the definite and indefinite integrals of functions.
4. Apply an appropriate model to the problem to be solved by (Gen Ed Comp A, B, C):
 - Writing the equation of a line tangent to a curve at a given point using derivatives.
5. Make inferences, evaluate assumptions, and assess limitations in estimation modeling and/or statistical analysis by (Gen Ed Comp A, D):
 - Analyzing information to develop models for solving application problems involving related rates, optimization, area under curves and velocity/acceleration.