South Central College

MATH 131 Calculus I

Course Outcome Summary

Course Information

Description This course introduces the key concepts of the derivative and the integral. Beginning with the definition of limit, the notion of continuity is developed which is perhaps the most important thread running throughout the calculus. This leads naturally to the process of differentiation and then integration, concluding with the all important Fundamental Theorem of the Calculus. Along the way, applications to classical and modern science, economics, the social sciences and other fields are explored. (Prerequisites: MATH 125 or MATH 130 with a grade of C or higher, or a score of 103 or higher on the College Level Mathematics portion of the Accuplacer test.) (MNTC 4: Mathematical/Logical Reasoning)

Total Credits 4

Total Hours 80

Types of Instruction

Instruction Type	Credits/Hours
Lecture	3
Lab	1

Pre/Corequisites

MATH 125 or MATH 130 with a grade of C or higher, or a score of 103 or higher on the College Level Mathematics portion of the Accuplacer test. (MNTC 4: Mathematical/Logical Reasoning)

Institutional Core Competencies

Critical and Creative Thinking - Students will be able to demonstrate purposeful thinking with the goal of using a creative process for developing and building upon ideas and/or the goal of using a critical process for the analyzing and evaluating of ideas.

Course Competencies

1. Model real-world phenomena with mathematical functions

Learning Objectives

Define function and associated terms precisely
Model linear behavior with linear functions
Model growth and decay behavior with exponential and logarithmic functions

Model circular and cyclic behavior with the trigonometric functions

2. Graph functions in the plane

Learning Objectives

Graph functions using transformations
Use symmetry properties to expedite graphing
Parameterize plane curves

3. Apply properties of common inverse functions

Learning Objectives

Deduce properties of inverse functions in general
Parameterize inverse functions
Explain the behavior of the logarithmic functions
Explain the behavior of the inverse trigonometric functions

4. Define the limit

Learning Objectives

Apply increments to problems concerning constant rates of change
Approximate change in a variable which varies continuously, using secant lines
Interpret a limit geometrically as constraining a function close to a certain value
Define limit precisely using the delta-epsilon notation
Demonstrate limiting behavior of common functions

5. Compute limits using proven methods

Learning Objectives

Deduce rules for easily finding limits of certain algebraic functions
Define one-sided limits of a function
Compute one-sided limits of a function

6. Extend the notion of limit to unbounded or asymptotic behavior

Learning Objectives

Determine where functions may grow without bound near a point
Compute limits of functions when domain values grow or decrease without bound
Explain how a function may fail to have a limit at a certain point in the domain

7. Explain the Intermediate Value Theorem

Learning Objectives

Interpret the Intermediate Value Theorem geometrically
Apply the Intermediate Value Theorem to root finding

8. Define continuity

Learning Objectives

Prove a certain function is continuous at a point in its domain
Prove a certain function is continuous everywhere
Invent a counterexample showing discontinuity of a function at a point in its domain
Define continuity precisely using the delta-epsilon notation
Derive properties of continuous functions from the definition

9. Define derivative

Learning Objectives

Interpret the derivative geometrically in terms of a tangent line
Interpret the derivative as an instantaneous rate of change
Define the derivative as the limit of a difference quotient
Define the one-sided derivative
Explain the connection between differentiability and continuity
Extend the definition to higher order derivatives

10. Compute derivatives of common functions

Learning Objectives
Show that the derivative is a linear operator
Compute the derivative of a polynomial
Extend differentiation rules to include negative exponents

11. Compute derivatives of combinations of functions

Learning Objectives
Compute the derivative of a sum of two functions
Compute the derivative of the difference of two functions
Compute the derivative of the product of two functions
Compute the derivative of the quotient of two functions
Compute the derivative of composite functions using the chain rule

12. Compute the derivatives of the trigonometric functions

Learning Objectives
Derive the limit formulas for expressions containing sines and cosines
Derive formulas for the derivatives of sine and cosine
Extend the formulas from (b), above, to the remaining trigonometric functions

13. Apply differentiation to functions expressed in other ways

Learning Objectives
Differentiate functions defined by parametric equations
Differentiate functions defined implicitly
Apply differentiation to situations modeled by related rates

14. Explain the Mean Value Theorem for Derivatives

Learning Objectives
Prove Rolle□s Theorem
Prove the Mean Value Theorem for Derivatives
Derive practical results from the Mean Value Theorem for Derivatives
Interpret the Mean Value Theorem for Derivatives graphically

15. Apply the differential calculus to analytic geometry

Learning Objectives
Explain the Intermediate Value Theorem
Use the first derivative test to locate intervals of increasing or decreasing behavior
Use the first and second derivatives to locate local extrema of a function
Use the second derivative to determine the concavity of the graph of a function
Use the second derivative to locate points of inflection on the graph of a function

16. Solve applied problems using differentiation

Learning Objectives
Apply differentiation to problems from business and economics
Apply differentiation to problems from the manufacturing industries
Apply differentiation to problems from mathematics, physics, optics and mechanics

17. Define differential

Learning Objectives
Define differential in terms of the derivative
Estimate rate of change with the differential
Approximate a function□s local behavior using a linear expression

18. Define antiderivative

Learning Objectives
Define antiderivative as an inverse operator
Derive rules for antiderivatives from those of derivatives
Apply antiderivatives to initial value problems and simple exact differential equations

19. Compute antiderivatives of combinations of functions

Learning Objectives
Demonstrate that the antiderivative is a linear operator
Compute an antiderivative using the power rule in integral form
Compute an antiderivative using substitution

20. Define the definite integral

Learning Objectives
Interpret expressions containing the sigma notation
Define the definite integral as the limit of a Riemann sum
Interpret area under a curve as a definite integral
Define average value as a definite integral

21. Compute the value of a definite integral

Learning Objectives
Demonstrate linearity for definite integrals
Demonstrate sign reversal when the order of integration is reversed
Explain the Mean Value Theorem for Integrals
Show max-min bounds for a definite integral

22. Prove the Fundamental Theorem of the Calculus

Learning Objectives
Differentiate a definite integral
Evaluate a definite integral by means of an indefinite integral

23. Evaluate definite integrals using substitution

Learning Objectives
Use substitution without changing the limits of integration
Use substitution while changing the limits of integration

24. Apply definite integrals to area problems

Learning Objectives
Compute the area under a curve
Compute the area between two curves

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