LAKELAND COMMUNITY COLLEGE – COURSE OUTLINE FORM

ORIGINATION DATE:	8/2/99	**APPROVAL DATE:**	2/27/23
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COURSE ID: **MATH2500**

COURSE TITLE: Calculus and Analytical Geometry I

	LECTURE	**LAB**	**CLINICAL**	**TOTAL**	**OBR MIN**	**OBR MAX**
CREDITS:	5.00	0.00	0.00	5.00	5.00	5.00
CONTACT HOURS:	5.00	0.00	0.00	5.00		

PREREQUISITE:

MATH 1700 OR PLACEMENT TEST

COURSE DESCRIPTION:

This is the first course in a three-semester sequence study of differential and integral calculus for students majoring in mathematics, science, or engineering. Topics include limits and continuity, the derivative, differentiation, the differential, applications of differentiation, the indefinite integral, the definite integral, and the calculus of the transcendental functions. Students will need to supply a graphing utility; the instructor will provide details.

RATIONALE FOR COURSE:

This is the first course in a three-semester sequence study of differential and integral calculus for students majoring in mathematics, science, or engineering.

OUTCOMES:
The course will

1. Present the fundamental concepts and basic techniques of differential and integral calculus in a clear and concise manner and at a level suitable for first year engineering, mathematics, and science students.

2. Introduce and develop the concepts of functions and graphs and the central role they play in the calculus.

3. Present the slope of a secant line as an average rate of change over an interval.

4. Develop careful analytic techniques using precise terminology, definitions, and properties.

5. Present the concepts of limits and continuity in a clear, concise manner.

6. Derive the basic rules of differentiating algebraic, logarithmic, exponential, trigonometric, inverse trigonometric, and hyperbolic functions.

7. Develop students' ability to differentiate proficiently.

8. Develop the slope of a tangent line as the instantaneous rate of change at a point.

9. Introduce the applications of the derivative to physical situations.

10. Define the anti-derivative and develop the definite integral as the limit of a Riemann sum.

11. State, prove, and apply the Mean Value Theorem for Derivatives, the Mean Value Theorem for Integrals, and the Fundamental Theorem of Calculus.

12. Derive the basic rules of anti-differentiation of algebraic, logarithmic, exponential, trigonometric, inverse trigonometric, and hyperbolic functions.

13. Develop students' ability to anti-differentiate proficiently.

PERFORMANCE INDICATORS:
Upon completion of the course, the student should be able to

1. Estimate limits of functions numerically and graphically.

2. Find limits of functions using the definition of a limit.

3. Find limits of functions using the limit theorems.

4. Determine and prove if a function is continuous or not at a given point and list the intervals of continuity of a function.

5 Classify the discontinuities of a function (removable or non-removable/essential)

6. Determine when a function satisfies the conditions of existence theorem (Intermediate Value, Extreme Value, Rolle's, and Mean Value Theorems)

7. Compute derivatives of algebraic and trigonometric functions using the definition and formulae.

8. Find equations of a line tangent to a curve.

9. Interpret the derivative as the instantaneous rate of change of one variable with respect to another variable.

10. Compute higher order derivatives.

11. Compute derivatives implicitly.

12. Solve related rate problems.

13. Compute infinite limits and evaluate limits at infinity. Interpret these results graphically as asymptotic behavior where applicable.

14. Determine maximum and minimum values of a function using the first and second derivative tests for relative extremae along with the Extreme Value Theorem, where applicable.

15. Apply maximum-minimum theory to application problems.

16. Use the first and second derivatives of a function to assist in sketching the graph of a function.

17. Use differentials and linearizations to approximate function values.

18. Use Newton's Method to approximate the zeros of a function.

19. Find anti-derivatives of algebraic and trigonometric functions using the basic formulae and substitutions.

20. Solve rectilinear motion problems using anti-differentiation.

21. Determine the area beneath a non-negative continuous function using the limit process.

22. Apply the Fundamental Theorem of Calculus to evaluate definite integrals.

23. Describe the relationship between the derivative of a one-to-one function and the derivative of its inverse.

24. Differentiate and integrate logarithmic and exponential functions.

25. Solve growth and decay problems.

26. Differentiate and integrate inverse trigonometric functions.

27. Differentiate and integrate hyperbolic functions.

COURSE OUTLINE:

I. Limits and Continuity
- A. The Limit of a function
  1. numerical and graphical estimation
  2. the formal (epsilon-delta) definition of limit
- B. Theorems on limits of functions
  1. limits and function arithmetic (including composition)
  2. The Squeeze Theorem
  3. special trigonometric limits
- C. Techniques for evaluating limits
- D. Continuity and one-sided limits
  1. The Intermediate Value Theorem
- E. Infinite limits
  1. vertical asymptotes
- F. Limits at infinity
  1. horizontal asymptotes
  2. slant/oblique asymptotes

II. Differentiation
- A. The derivative and the tangent line problem
- B. Basic differentiation rules for algebraic and trigonometric functions
  1. sum and difference
  2. constant multiple
  3. power rule
  4. product and quotient
- C. The derivative as an instantaneous rate of change
- D. Higher order derivatives
  1. position, velocity, and acceleration functions
- E. The Chain Rule
- F. Implicit differentiation
- G. Related rates

IV. Applications of Differentiation
- A. Extrema on an interval
  1. the Extreme Value Theorem
  2. critical numbers
- B. Rolle's Theorem and the Mean Value Theorem
- C. Increasing and decreasing functions and the first derivative test
- D. Concavity and the second derivative test
- F. Curve sketching
  1. first derivative test and intervals of increase/decrease
  2. second derivative test and intervals of concave up / down
  3. limits and asymptotes

4. relative extrema
5. inflection points

G. Optimization problems
H. Newton's method
I. Differentials

V. Integration
A. Anti-derivatives and indefinite integration
B. Area under a curve using a limit process
C. Riemann sums and definite integrals
D. The Fundamental Theorem of Calculus
1. The Mean Value Theorem of Integrals
E. Integration by substitution
F. Numerical Integration
1. The Trapezoidal Rule
2. Simpson's Rule
3. graphing utilities

VI. Logarithmic, Exponential, and Other Transcendental Functions
A. The natural logarithmic function and differentiation
B. The natural logarithmic function and integration
C. Inverse functions
D. Exponential functions: differentiation and integration
E. Bases other than e and applications
F. Growth and decay
1. unlimited / uninhibited growth / decay models
2. limited models: Newton's Law of Cooling / Warming
3. logistic growth
G. Inverse trigonometric functions and differentiation
H. Inverse trigonometric functions and integration
I. Hyperbolic functions: differentiation and integration

INSTRUCTIONAL PROCEDURES THAT MAY BE UTILIZED:

Lecture/discussion
Computer/graphing calculator based activities
Group and/or individual activities
Research projects utilizing real data gathered from the Internet or other sources

GRADING PROCEDURES:

It is recommended that the instructors have at least five evaluative items on which to determine the student's course grade. In general, tests are given covering lecture and homework assignments.

COURSE EVALUATION PROCEDURES:

Student course evaluations
Student success rate in subsequent mathematics courses

LAKELAND LEARNING OUTCOMES

		I	R	D
	LEARNS ACTIVELY			
1.	Takes responsibility for his/her own learning.			D
2.	Uses effective learning strategies.			
3.	Reflects on effectiveness of his/her own learning strategies.			
	THINKS CRITICALLY	**I**	**R**	**D**
4.	Identifies an issue or idea.			
5.	Explores perspectives relevant to an issue or idea.			
6a.	Identifies options or positions.			
6b.	Critiques options or positions.			
7.	Selects an option or position.			D
8a.	Implements a selected option or position.			
8b.	Reflects on a selected option or position.			
	COMMUNICATES CLEARLY	**I**	**R**	**D**
9a.	Uses correct spoken English.			
9b.	Uses correct written English.			
10.	Conveys a clear purpose.			
11.	Presents ideas logically.			D
12a.	Comprehends the appropriate form(s) of expression.			D
12b.	Uses the appropriate form(s) of expression.			D
13.	Engages in an exchange of ideas.			
	USES INFORMATION EFFECTIVELY	**I**	**R**	**D**
14.	Develops an effective search strategy.			
15a.	Uses technology to access information.			D
15b.	Uses technology to manage information.			
16.	Uses selection criteria to choose appropriate information.			D
17.	Uses information responsibly.			
	INTERACTS IN DIVERSE ENVIRONMENTS	**I**	**R**	**D**
18a.	Demonstrates knowledge of diverse ideas.			
18b.	Demonstrates knowledge of diverse values.			
19.	Describes ways in which issues are embedded in relevant contexts.			
20a.	Collaborates with others.			
20b.	Collaborates with others in a variety of situations.			
21.	Acts with respect for others.			

Definitions:

Introduces (I)

Students first learn about key ideas, concepts, or skills related to the performance indicator. This usually happens at a general or very basic level, such as learning one idea or concept related to the broader outcome.

Reinforces (R)

Students are given the opportunity to synthesize key ideas of skills related to the performance indicator at increasingly proficient levels.

Demonstrates (D)

Students should demonstrate mastery of the performance indicator with the level of independence expected of a student attaining an associate's degree.