LAKELAND COMMUNITY COLLEGE - COURSE OUTLINE FORM

ORIGINATION DATE:	8/2/99	**APPROVAL DATE:**	2/27/23
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COURSE ID: **MATH2850**

COURSE TITLE: Differential Equations

	LECTURE	LAB	CLINICAL	TOTAL	OBR MIN	OBR MAX
CREDITS:	4.00	0.00	0.00	4.00	4.00	4.00
CONTACT HOURS:	4.00	0.00	0.00	4.00		

PREREQUISITE:

MATH 2500 and MATH 2600 or permission of instructor

COURSE DESCRIPTION:

This course includes a study of techniques for solving first order differential equations, techniques for solving linear differential equations, elementary applications, power series solutions, the Runge-Kutta method, the Laplace transform, and applications of differential equations to physical problems. Students will need to supply a graphing utility; the instructor will provide details.

RATIONALE FOR COURSE:

This course includes a study of techniques for solving differential equations. It is designed for students planning to transfer to a mathematics, physics, engineering, chemistry, or computer science four-year program.

OUTCOMES:
The course will

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

2. Further develop students' ability to apply mathematical abstraction to concrete applications.

3. Develop students' understanding of and ability to use differential equations as a tool.

4. Further develop students' ability to use theorems and definitions in combination.

5. Provide a further study of mathematical abstraction, logical reasoning, the precision of a mathematical argument, and the construction of proofs.

6. Develop the use of technology as a tool for determining solutions to real-life applications.

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

1. Classify a given differential equation as either an ordinary or partial differential equation.

2. State the order of a given differential equation.

3. Determine whether a given differential equation is linear or nonlinear.

4. Verify that a given function is a solution to a given differential equation.

5. Verify that a given function is a solution to a given initial or boundary-value problem.

6. Verify that an initial-value problem associated with a differential equation of the form $y' = f(x, y)$ satisfies the hypothesis of a basic existence and uniqueness theorem.

7. Identify and solve exact, separable, homogeneous, linear, and Bernoulli first-order ordinary differential equations and initial-value problems.

8. Find special integrating factors and transformations to solve first-order ordinary differential equations and initial-value problems.

9. Apply first-order ordinary differential equations to the solution of applications chosen from problems in mechanics, orthogonal trajectories, falling body problems, growth and decay problems, population problems, and mixture problems.

10. Determine whether or not a given set of functions is linearly independent on a given interval using the Wronskian.

11. Verify that an initial-value problem associated with a nth-order linear ordinary differential equation satisfies the hypothesis of a basic existence and uniqueness theorem.

12. Solve homogeneous linear ordinary differential equations with constant coefficients.

13. Solve initial-value problems associated with homogeneous linear ordinary differential equations with constant coefficients.

14. Apply the method of undetermined coefficients to solve non-homogeneous linear ordinary differential equations with constant coefficients.

15. Apply the method of undetermined coefficients to solve initial-value problems associated with non-homogeneous linear ordinary differential equations with constant coefficients.

16. Apply the method of variation of parameters to solve higher-order linear ordinary differential equations, and initial-value problems associated with higher-order linear ordinary differential equations.

17. Apply second-order linear ordinary differential equations with constant coefficients to the solution of electric circuit problems, vibrations of a mass on a spring problems, and problems that deal with resonance phenomena.

18. Approximate solutions to initial-value problems associated with differential equations of the form $y' = f(x, y)$ using graphical methods (slope fields), Euler's Method, and the Runge-Kutta method.

19. Solve initial-value problems associated with linear ordinary differential equations with constant coefficients using Laplace transforms and their inverse transforms.

COURSE OUTLINE:

I. Differential Equations and their Solutions
   A. Classification of differential equations; their origin and application
   B. Solutions
   C. Initial-value problems, boundary-value problems, and existence of solutions

II. First-Order Equations for Which Exact Solutions are Obtainable
   A. Exact differential equations and integrating factors
   B. Separable equations and equations reducible to this form
      1. homogeneous equations
   C. Linear equations and bernoulli equations
   D. Special integrating factors and substitutions
      1. reduction of order

III. Applications of First-Order Equations Chosen From the Following
   A. Orthogonal trajectories
   B. Problems in mechanics
      1. falling body problems
   C. Population problems
      1. unlimited growth / decay
      2. limited growth / decay
         a. Netwon's Law of Cooling / Warming
      3. logistic models
   D. Mixture problems
   E. Electric circuit problems

IV. Approximate Methods of Solving First-Order Equations
   A. Graphical methods
      1. slope fields
   B. Numerical methods:
      1. Euler's method
      2. the Runge-Kutta method

V. Explicit Methods of Solving Higher-Order Linear Differential Equations
   A. Basic theory of linear differential equations
   B. The homogeneous linear equation with constant coefficients
   C. The method of undetermined coefficients
   D. Variation of parameters

VI. Applications of Second-Order Linear Differential Equations with Constant Coefficients
   A. The differential equation of the vibrations of a mass on a spring
      1. free, undamped motion
      2. free, damped motion
      3. forced motion
      4. resonance phenomena
   B. Electric circuit problems

VII. The Laplace Transform
   A. Definition, existence, and basic properties of the Laplace transform
   B. The inverse transform and the convolution
   C. Laplace transform solution of linear differential equations with constant coefficients
   D. Laplace transform solution of linear differential equations with discontinuous non-homogeneous terms

VIII. Series Solutions of Linear Differential Equations (as time permits)
   A. Review of power series
   B. Power series solutions about an ordinary point
   C. Solutions about regular singular points
      1. method of Froebenius

2. Bessel’s equation

IX. Systems of Linear Differential Equations (As time permits.)
   A. Solutions of systems
   B. Homogeneous linear systems
   C. Constant coefficient
   D. Solutions structure as related to eigenvalue multiplicity

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.			

		I	R	D
	THINKS CRITICALLY			
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.			

		I	R	D
	COMMUNICATES CLEARLY			
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.			

		I	R	D
	USES INFORMATION EFFECTIVELY			
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.			

		I	R	D
	INTERACTS IN DIVERSE ENVIRONMENTS			
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.			D
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.