

**EMBRY - RIDDLE AERONAUTICAL UNIVERSITY**  
**Department of Computing and Mathematics**  
**COURSE OUTLINE FOR**

**Course No.** MA345      **Title:** Differential Equations & Matrix Methods  
**Cr. Hrs.**      4

**Lecture Hours:** 4      **Laboratory Hours:** 0

**COURSE DESCRIPTION:**

Treatment of ordinary differential equations to include principle types of first and second order equations; methods of substitution on simple higher order equations; linear equations and systems of linear equations with constant coefficients; methods of undetermined coefficients and variation of parameters; Laplace transforms; series solutions; linear algebra and matrix methods of solutions; applications to physics and engineering. Prerequisite: MA243

**GOALS:**

This course is required by the Aerospace Engineering, Electrical Engineering, Avionics, Engineering Technology and Engineering Physics degree programs. Its purpose is to provide intermediate mathematical skills for the student to use in many of the applications he will encounter in future engineering courses.

**PERFORMANCE OBJECTIVES:**

1. Recognize and solve separable, homogeneous, exact, and linear first order differential equations.
2. Construct and solve appropriate differential equations for applied problems involving mixtures, populations, and Newtonian Mechanics.
3. Calculate numerical solutions of differential equations.
4. Solve homogeneous, linear second and higher order differential equations with constant coefficients.
5. Solve nonhomogeneous, linear second and higher order differential equations with constant coefficients by the Method of Undetermined Coefficients and the Method of Variation of Parameters.
6. Construct and solve applied problems involving mechanical vibrations, forced vibrations, and electric circuits.
7. Compute Laplace transforms of polynomials, exponential and trigonometric function.

8. Compute inverse Laplace transforms of rational function and solve initial-value problems by Laplace Transform Method.
9. Find a power series solution to a given differential equation.
10. Solve a linear system by the Gauss-Jordan elimination method and by Matrix Methods.
11. Compute eigenvalues and eigenvectors of a given matrix.
12. Solve systems of 1st order linear differential equations by Matrix Methods.

Reviewed and Approved by:



Daytona Beach Campus

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Chair Date

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Dean of Academics Date



Prescott Campus

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Extended Campus

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Dean of Academics Date

**Department of Computing and Mathematics**  
**COURSE OUTLINE FOR MA345, Continued**

**TEXTBOOK:**

Nagel, and Saff, *Fundamentals of Differential Equations*, 4th Edition,  
 Addison Wesley, 1996.

**SUGGESTED SUPPLEMENTAL MATERIALS:**

- a. Robert L. Borrelli and Courtney S. Coleman, *Differential Equations, Modeling Perspectives*, John Wiley and Sons, 1997.
- b. Beverly West, Steven Strogatz, Jean Marie McDill and John Cantwell, *Interactive Differential Equations*, Addison Wesley, 1997.

**PERQUISITE KNOWLEDGE BY TOPIC:**

1. Properties, derivatives, integrals, and inverses of all the elementary functions. This includes the trigonometric functions, logarithms and exponentials, power functions and hyperbolic functions.
2. Techniques of integration, including integration by parts, variable substitution, trigonometric substitution, and the method of partial fractions decomposition.
3. L'Hospital's rule.
4. Improper integrals.
5. Partial derivatives.
6. Determinants and Cramer's Rule.
7. Taylor Series.
8. Vectors, including vector addition, scalar multiplication and dot product.

<b>Topics</b>	<b>Class Hours</b>	<b>Course Objectives</b>
1. First order and simple higher order differential equations.	9	Understand the concepts of a general solution, an initial or boundary condition and the order of a differential equation. Solve equations using techniques such as direct integration, exact differentials, separation of variables, integrating factors and special variable substitutions.

Con't TOPICS	CLASS HOURS	COURSE OBJECTIVES
2. Linear homogeneous differential equations -constant coefficients.	8	Understand the concepts of linear operators & linear independence of solutions. Be able to use the Wronskian determinant to test for linear independence. Solve linear homogeneous differential equations in which the solutions of the auxiliary equation are real, complex or repeated. Use Euler's formula to express complex exponentials in terms of sine and cosine.
3. Nonhomogeneous linear differential equations.	6	Recognize the general form of solutions of nonhomogeneous equations. Use the methods of variation of parameters and either the method of undetermined coefficients or operator methods to construct particular solutions.
4. Applications of linear differential equations.	2	Formulate and solve some simple spring and circuit problems involving linear differential equations with constant coefficients. applications include mechanical resonance.
5. Laplace transforms.	5	Compute Laplace transforms of polynomials, trigonometric and exponential functions. Compute inverse Laplace transforms of rational functions. Use Laplace transforms to solve differential equations.
6. Numerical solutions of differential eqtns.	3	Use linear approximations and power series to solve differential equations.
7. Matrix algebra	3	Multiply matrices by scalars. Add and multiply matrices. Represent systems of linear algebraic equations as matrices and solve by matrix reduction.
8. Matrix inverses	3	Find inverses of matrices using either determinants or matrix reduction. Use matrix inverses to solve systems of linear equations.
9. Eigenvectors and eigenvalues	3	Compute eigenvectors and eigenvalues of a given matrix.

**LABORATORY:**

None

**COMPUTER USAGE:**

Use local computer laboratory, MAPLE, Interactive Software

**GRADING SYSTEM:**

Varies with each instructor; however grades are usually based on in-class tests, homework and a comprehensive final exam.

**ESTIMATED CONTENT:****Skills 50%**  
**Content 50%**

Signature			
Prepared by:	Seenith Sivasundaram Course Monitor	Date	at Daytona Beach Campus
Signature			
Coordinated by:	William Grams Associate Chair, Department of Computing and Mathematics	Date	at Daytona Beach Campus