

**VIRGINIA STATE UNIVERSITY
SCHOOL OF AGRICULTURE, SCIENCE AND TECHNOLOGY
DEPARTMENT OF MATHEMATICS & COMPUTER SCIENCE
MATH 350 – Introduction to Differential Equations - 3 Semester Hours
COURSE SYLLABUS SPRING 2004**

Instructor's Name: _____

Instructor's Office Location: _____

Instructor's Office Phone: _____ **Instructor's E-mail:** _____

Departmental Fax Number: (804) 524-5746

Instructor's Office Hours:

Monday	Tuesday	Wednesday	Thursday	Friday

COURSE DESCRIPTION: Solutions of ordinary differential equations with application to sciences.

Prerequisite: MATH 201 - Calculus II

Recommended Text: Zill, Dennis G. (1997). A First Course in Differential Equations with Modeling Applications. 6 th ed. Brooks/Cole Publishing Company, Boston, MA.

Learning Outcomes and Evaluation Procedures

In this course, the student will acquire the following Knowledge, Skills and Abilities:

KNOWLEDGE

1. The student will define the following terms: Differential equations; ordinary and partial differential equations, order of differential equations; linear and nonlinear differential equations; solution of a differential equation; explicit, implicit, trivial, singular solution, and general solution of a differential equation; system of differential equations; initial and boundary value problems; mathematical model; exact differential equation; standard form of linear first-order differential equations; Bernoulli=s equation; linearly independent and linear

- dependent solutions; Wronskian of a set of functions; homogeneous and non-homogeneous equations; auxiliary equations or characteristic equations; relative error, absolute error and percentage relative error.
2. The student will recall solution of first order linear differential equations by separation of variable technique.
 3. The student will recall criteria for exact differential equations.
 4. The student will recall variation of parameter technique to solve first order differential equations.
 5. The student will recall special algorithm to develop mathematical models for Physical, sociological and economical problems.
 6. The student will recall Wronskian test for linear independence of solutions.
 7. The student will recall principle of superposition.
 8. The student will recall techniques to solve second degree non-homogeneous and homogeneous linear differential equations.
 9. The student will recall Laplace Transform techniques to solve differential equations.
 10. The student will recall numerical techniques to solve differential equations.

SKILLS

1. The student will demonstrate ability to:
 - a. Distinguish between linear and non-linear differential equations.
 - b. Distinguish between ordinary and partial differential equations
2. The student will demonstrate ability to solve first order differential equations by
 - a. Separation of variable
 - b. Variation of parameter.
 - c. Substitution.
3. The student will demonstrate ability to solve exact differential equations.
4. The student will demonstrate ability to develop mathematical models for Physical, Sociological and Economical problems.
5. The student will demonstrate skills to solve homogenous linear equations with constant coefficients.
6. The student will demonstrate skills to solve second degree non-homogeneous linear differential equation by using principle of superposition, undetermined coefficients, and variation of parameters.
7. The student will demonstrate skills to solve differential equations by power series method.
8. The student will apply Laplace Transform technique to solve differential equations.
9. The student will demonstrate ability to find numerical solutions to differential equation by using Euler & method, Improved Euler & method, first, second, and fourth-order Runge - Kuffa method.
10. The student will use computer software to find numerical solutions to differential equations.

ABILITIES

1. The student will develop mathematical models of some real-life systems or phenomenon from physical, sociological or even economic.
2. The student will select the proper techniques to solve a given differential equation.
3. Given a physical, sociological or economical problem, the student will use analytic technique to develop a mathematical model, solve the mathematical model and interpret the mathematical results back into the context of the original problem.

COURSE CONTENTS

Following topics from textbook will be covered.

1. Introductory Concepts
 - 1.1 Basic Definitions and Terminology
 - 1.2 Origins of Differential Equations
2. First-Order Differential Equations
 - 2.1. Solution of Differential Equations by
 - a. Separation of Variables
 - b. Substitution method
 - c. Picard's Method
 - 2.2 Linear Equations
 - 2.3 Homogeneous Equations
 - 2.4 Exact Equations
3. Linear Differential Equations of Higher Order
 - 3.1 Linearly independent solutions
 - 3.2 Using one solution to find another
 - 3.3 Homogeneous equations with constant coefficients:
Real Roots and Complex roots
 - 3.4 Non-homogeneous equations: The method of undetermined coefficients, and
Variation of constants.
 - 3.5 The solution of homogeneous linear systems with constant coefficients: The
method of determinants
4. Applications of Second-Order Differential Equations
 - 4.1 Simple Harmonic Motion
 - 4.2 Damped Motion
 - 4.3 Forced Motion
 - 4.4 Electric circuits and other Analogous systems
5. Laplace Transform

- 5.1 Laplace Transform
 - 5.2 Inverse Transform
 - 5.3 Solution of differential equations using Laplace Transform
6. Power series Solution to the Differential equations
- 6.1 Review of Power Series
 - 6.2 The power series method
7. Numerical Methods
- 7.1 Direct Fields
 - 7.2 Euler's Method
 - 7.3 The Three-Term Taylor Method
 - 7.4 The Runge-Kutta Method
 - 7.5 Milne's Method, Second-Order Equations, Errors,

GRADING SYSTEM: The following components will determine the final grade:

Test - Four one hour tests. Each test will be worth 100 points. Test questions will come from problems discussed in class, home assignments, solved examples in the text, and any other assigned problems. Tests will be announced in advance and you will have plenty of time to prepare for the tests. You can expect one test every other week.

HOME ASSIGNMENTS - During each class period you will be assigned ten to fifteen problems. You are expected to complete your home assignment. If you encounter difficulty in completing assignments, seek help from your class fellows, mathematics lab, come to my office, or any other source. If you still can't solve it, please ask in next class period. I will not collect home assignments but will make a note whether you have done home assignments or not. This information will be used to adjust your grade if your grade average is within one or two percent of the next grade.

QUIZZES - Before the class ends, I will pick one problem from the home assignment and ask you to do it in class. This one problem quiz will be worth 10 Points. You can expect a quiz from home assignments every time class meets. We will have 12 quizzes and will pick best ten for you. There is no makeup for quizzes.

MID-TERM EXAMINATION - Mid-term examination will be conducted mid-way through the semester. It will include all the material covered up to that time. It will be worth 100 points.

FINAL EXAMINATION - Final examination will be conducted at the end of the semester and it will be worth 200 points. It will include all the material covered during the semester.

RESEARCH PAPER - Each student will select a topic to describe a physical problem from some scientific field. The problem should be such that its mathematical model involve differential equation(s). Research paper should include the following:

- a. Statement of the problem
- b. Its Mathematical Model
- c. Solution of the system
- d. Interpretation of the solution

COMPUTER ASSIGNMENT - There will be two assignments involving numerical solution of differential equations. Each assignment will involve use of computer technology.

FINAL AVERAGE

	<u>Points</u>
Computer Assignments	100
Research Paper.....	100
Tests.....	400
Quizzes.....	100
Midterm.....	100
Final.....	<u>200</u>
	1000

LETTER GRADE

A: 90 - 100 B: 80 - 89 C: 70 – 79 D: 60 - 69 F: Below 60

CLASS ATTENDANCE

Class attendance is mandatory for freshman students. You are not freshmen but as a survivor in an academic environment you have realized the importance of class attendance. It is strongly recommended that you continue your good habit and maintain regular class attendance.

BIBLIOGRAPHY

1. Differential Equations - Computing and Modeling, by C. H. Edwards, Jr., & David E. Penney, 1996, Prentice Hall, Englewood Cliffs, New Jersey.
2. Differential Equations and Boundary Value Problems, by R. Kent Nagle & Edward B. Saff, 1993, Addison Wesley Publishing Company, Reading, MA.