Salisbury University Department of Mathematical Sciences

MATH 311: Differential Equations I
Syllabus (Tentative)

Description: This course provides a foundational introduction to ordinary differential equations. Students will learn core techniques for solving and analyzing first- and second-order differential equations, including both linear and nonlinear types, as well as systems of equations. The course emphasizes a balanced approach that includes analytical methods for finding exact solutions, qualitative techniques for understanding equations/solutions, and numerical approaches using technology to approximate solutions. Students will also use mathematical software to explore and visualize solutions.

Prerequisites: C or better in MATH 202.

Intended Audience: Majors in Mathematical or Physical Sciences and students in the Dual-Degree Engineering Program.

Objective: To study differential equations and their applications.

Textbooks: *Fundamentals of Differential Equations*, by R. Kent Nagle, Edward B. Staff, Arthur David Snider; Addison-Wesley, 9th Edition.

Technology: At least one assignment must make significant use of a programming language (e.g. Python, MATLAB, Mathematica, Maple, etc.). Which topics this is used for is left to faculty preference.

Topic	Weeks
Introduction to Differential Equations	1.5
Basic Definitions and Terminology, Directed Fields, Phase Portraits.	
First Order Differential Equations	2
Preliminary Theory (initial value problems), Separable Equations, Exact Equations, Linear Equations, Properties of Nonlinear vs. Linear equations, Models and Applications.	
Numerical Methods	1.5
Elementary numerical methods: Euler, Improved Euler, Runge-Kutta Methods.	
Second Order Equations	3
Theory of Linear Equations, Homogeneous Linear Equations with Constant Coefficients, Reduction of Order, Methods of Undetermined Coefficients and Variation of Parameters for Non-homogeneous Equations, Mechanical and electrical vibrations.	
Laplace Transforms	1.5
Definition and calculation of transforms, Applications to differential equations with discontinuous forcing functions.	
Systems of First Order Linear Equations	2
General theory, Eigenvalue-eigenvector method for systems with constant coefficients.	
Nonlinear Systems and Stability	1
Autonomous systems and critical points, Stability and phase plane analysis of almost linear systems.	
Exams	1.5
Total	**14**

Evaluation

Examinations	35 - 60%
Assignments/Quizzes	20 - 40%
Comprehensive Final Exam	20 - 40%

- Clear descriptions of thought processes, evidence of critical thinking, and effective communication must be demonstrated in written work.
- **Writing Across the Curriculum:** Students will be expected to communicate mathematics and mathematical ideas effectively in speech and writing. At the University Writing Center, trained consultants are ready to help you at any stage of the writing process. In addition to the important writing instruction that occurs in the classroom and during professors' office hours, the Center offers another site for learning about writing. **All students are encouraged to make use of these important services.**
- **NOTE:** Once a student has received credit, including transfer credit, for a course, credit may not be received for any course with material that is equivalent to it or is a prerequisite for it.