MATH 242 (Section 1) – Elementary Differential Equations

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WWW URL `http://www.math.scarolina.edu/~meade/math242/`

Meeting Times MWF 10:10AM – 11:00AM, SWGN 1D11

Office Hours MW 4:00–5:00, Th 11:00–12:00; appointments for other times must be made in advance.

Text Nagle and Saff, *Fundamentals of Differential Equations*, 3$^{\text{rd}}$ Edition, 1993, Addison–Wesley.

Prerequisite Completion of Math 142 with a grade of C or better.

Course Content Differential equations is one of the "languages" utilized by scientists and engineers to model the physical world. In this course we will learn both how to solve and analyze the solutions to differential equations and how to use differential equations to describe different phenomena. This material is presented in Chapters 1–5 and 7 of the text. Additional topics from Chapter 9 will be discussed as time permits.

The basic mathematical tools that will be used in our investigation of differential equations include algebra skills such as partial fractions, roots of polynomials, and solutions to systems of algebraic equations, and calculus techniques for derivatives, definite and improper integrals, and Taylor polynomials. You will be expected to utilize all of these at various times throughout the semester.

The computer will be used extensively in this course. All "programming" will be done using the Maple software package. Maple provides a convenient interface to symbolic, numerical, and graphical interpretations of a variety of mathematical objects. Supplemental materials will be distributed at appropriate times.

Applications of differential equations will be used to introduce most topics. Below is a listing of topics and applications that we will discuss.

Chapter 1 Introduction
- graphical interpretation of ODEs
- numerical methods

Chapter 2 First-Order ODEs
- Newton's second law
- chemical reactions

Chapter 3 Mathematical Models and Numerical Methods
- compartment problems
- population models

Chapter 4 Linear Second-Order ODEs
- more Newtonian mechanics

Chapter 5 More Applications and Numerical Methods
- mechanical vibrations
- harmonic motion

Chapters 7 and 9 Laplace Transforms and Systems of ODEs
- electrical circuits
- systems of ODEs

Grading Your grade in this course will be based on your performance on daily homework assignments, 2 group projects, 4 mid-term exams, and a final exam. The weights assigned to each of these components will be:

Mid-term exams (3)	45%
Homework (30)	15%
Projects (2)	15%
Final exam	25%

Course grades will be determined according to the following scale:

A	90 –100
B	80 – 89
C	70 – 79
D	60 – 69
F	0 – 59

Exams The 4 mid-term exams will be given in class. *Tentative* dates for these exams are:

Wednesday, February 1
Wednesday, February 22
Friday, March 31
Monday, April 24

Your lowest exam score will be not be counted in your final average. *No make-up exams will be given.*

A comprehensive final will be given at 9:00A.M. on Wednesday, May 3, 1995.
(Do not trust exam schedules published by unofficial sources, e.g. the Mortar Board.)

Homework Assigned problems will be collected as each section of the text is completed. Each homework assignment will be graded on both quantity and quality. Quantity, the number of problems you worked, will be 75% of the score; quality, the correctness of selected problems, will account for the remaining 25%. Your homework grade will be determined by your thirty (30) highest homework scores. Homework will be graded and returned as quickly as possible. Assignments may be done individually or together with one partner. *No late homework will be accepted.*

Projects In addition to the homework and exams, there will be two (2) projects. These reports will involve the use of the computer and Maple. The final version must be produced using a word processor, no hand-written reports will be accepted. In addition to the scientific content of your report, you will be graded on your use of written English. This means I will be looking at such items as spelling, grammar and correct use of mathematical and engineering terminology.

Tentative due dates for the projects are:

Friday, March 3
Friday, April 21

Late projects will be penalized 10% each day that they are late.

Computer Labs The Maple software is available on the computers on the Engineering network, on the PCs in PSC, and many workstations throughout campus. You may use any computer for the homework and projects. You will be expected to use the PCs in 1D11 in class and on the exams.

Academic Honesty Cheating and plagiarism will not be tolerated in this course. You may discuss homework problems with others, but do not copy solutions from another student or from a book. Violations of this policy will be dealt with in a matter consistent with University guidelines.

More about Projects

What is a Project?

Mathematical projects are included in this course to provide experience applying mathematics to problems from other disciplines: chemistry, engineering, physics, electronics, biology, ... The projects, which reinforce and expand on concepts presented in class, are designed to:

- develop independent analytical thinking by combining intuition, generalization and logical argument,
- build the skills to mathematically model a situation by defining variables, establishing relations between them, and working deductively towards an end result,
- cultivate an appreciation of mathematics as an evolving entity created and discovered by human enterprise.

The project-based approach is based on the premises that the learning and retention of mathematical concepts can be enhanced through i) exploration, ii) the process of passing from specific examples to general principles, and iii) discussing ideas with others along the way. Thus the projects are multi-step explorations and are prepared in a group of 3 or 4 students. You are strongly encouraged to discuss your ideas with others.

I will be available to provide guidance. But, while I will gladly answer questions, the reply will often be in the form of another question whose answer will direct you towards the answer to your original question. A project is yours to explore — and enjoy.

Participation in the projects will not only help you gain mathematical expertise, but will also help you prepare for your upcoming career in several other aspects. For example, you will likely have to apply your learned expertise on a group project. This is an opportunity to develop a personal style in helping maximize the group's efforts. It is also likely you will have to prepare technical reports. This is an opportunity to develop such writing skills. And, you will have to meet deadlines. This is an opportunity to develop time management skills.

Logistics

A project is a major lengthy assignment. Start immediately – let your subconscience work for you – immerse yourself in the project.

You should plan your first group meeting as soon as possible. But before the first meeting, you should have read the project carefully and given it some thought. At your first meeting, you should plan a method of attack – keeping in mind that all members of the group are expected to understand all parts of the solution.

The project report (one per group) should clearly explain and support your conclusions. It should be a mixture of prose (written in complete sentences), equations, formulas, charts, diagrams, etc. Proper grammar, spelling, and punctuation are important.

An ungraded preliminary report is due *no later than* one week prior to the due date. The entire team should schedule a meeting with me to discuss the project. I will not read the report for correctness or writing mistake; I will only make suggestions of general improvements where necessary.

Your project solution should be written in such a way that it can be read and understood by student in our class. You will be graded on your written presentation, including effective use of technical terminology, mathematical content and the quality and correctness of your final conclusions. It is not essential that projects be prepared on a word processor (or Maple), but if handwritten, it must be neat and legible.

Helpful Suggestions

- You will be responsible for choosing the members of your group. You should consider a number of factors when forming your group. In particular, check that all group members can meet at a common time.
- Keep good notes of your work. Remember the mistakes that you make, and try to learn from them. Be sure that each team member knows their responsibilities to the overall team effort.
- Some parts of the project will be most easily solved by hand, others using the computer. Feel free to use any software (Maple, QuattroPro, etc.) that will be useful.
- Do not procrastinate!

Sample Outline for Project Report

- **Title page.** Authors, date, course number, and title (be creative).
- **Introduction.** Background, problem statement, and general approach used to analyze the problem.
- **Body.** Contents of the body of the final report will depend on the type of the project, but will probably include some or all of the following:
  - if mathematical modeling is involved, the physical phenomenon should be described. Explain why the equations portray the physical system. Derive the model and discuss its accuracy, limitations, and possible improvements.
  - the "point" of the problem;
  - the mathematical principles used;
  - the method of solution employed;
  - the results of the investigation. Do the results match the expectations? If not, how can they be justified?
- **Conclusion.** Summarize results; in particular, provide a physical interpretation.
- **References.** List references (alphabetically by author) and other resources (including software).
- **Appendices.** Contain material necessary to support the body and conclusion of the project report, including:
  - Carefully labelled figures, graphs, and tables.
  - Detailed derivations, calculations, or procedural notes.

Project Grades

A number of different criteria will be used to evaluate the projects. The following table summarizes the different qualities that I will be evaluating. The majority of each project's grade (80%) will be the same for all group members; the remaining 20% will be graded on an individual basis.

Criterion	Points
preliminary report	5
evidence of group work	5
technical clarity	5
technical correctness	10
technical thoroughness	10
overall quality	5
individual component	10

Note: The point distribution is only approximate.