MAT225 Differential Equations

Spring 2020 – Revised 2020-04-14

General Information

Meeting Time and Place

Monday, Wednesday, and Friday: 8:00–9:00 a.m., KOSC 127.

Professor

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Office Hours

Monday & Wednesday: 3:20–4:20 p.m.,
Tuesday & Thursday: 1:00–3:00 p.m.,
and by appointment.

Text

Elementary Differential Equations, 10th Edition, William E. Boyce and Richard C. DiPrima, John Wiley & Sons, Inc. 2012.

Online materials associated with this class can be found on the departmental web server at *http://www.math-cs.gordon.edu/courses/mat225*.

Prerequisite

Satisfactory completion of MAT222 or equivalent, or permission of the instructor.

Academic Accommodations

Our academic community is committed to providing access to a Gordon education for students with disabilities. A student with a disability who intends to request academic accommodations should follow this procedure:

1. Meet with a staff person from the Academic Success Center (ASC) and provide them with current documentation of the disability;
2. Obtain a Faculty Notification Form from the ASC, listing appropriate accommodations; and
3. Submit this form to professors and discuss those accommodations with them, ideally within the first two weeks of classes.

Some accommodations need more time to arrange so communicating early in the semester is important. For more information consult http://www.gordon.edu/academicaccessibility or email asc@gordon.edu.

Academic Dishonesty

Academic dishonesty is regarded as a major violation of both the academic and spiritual principles of

this community and may result in a failing grade or suspension. Academic dishonesty includes plagiarism, (see Plagiarism in Student Handbook), cheating (whether in or out of the classroom), and abuse or misuse of library materials when such abuse or misuse can be related to course requirements.

Course Description

Introduction

Beginning with your study of integration in calculus you have been studying methods for the solution of differential equations; evaluating an integral is in some sense solving a simple differential equation. In this course we will study a host of more complicated differential equations. Part of our effort will be spent merely classifying the equations, an important step towards understanding and ultimately solving the mathematical problem. We will examine first and second order linear equations, systems of linear equations and some nonlinear equations.

The solutions of differential equations, when they exist at all, will be arrived at by a variety of methods. At times you may feel like this approach to solving differential equations involves much hand waving and pulling solutions out of thin air. There is some ground for this belief; a perfectly acceptable approach to solving a differential equation is to guess at a solution and then use substitution to see if it is indeed the solution. We will find, however, that the theory for first and second order linear differential equations is very well developed and little guesswork will be necessary.

Learning Outcomes

Students successfully completing this course will be able to:

- classify ordinary differential equations (ODEs) using the criteria: linear or non-linear, order, homogeneity, and constant or variable coefficients,
- use qualitative techniques to determine behavior of solution of first order ODEs,
- solve first-order ODEs and some higher order linear ODEs with constant coefficients,
- solve systems of first-order linear ODEs with constant coefficients and understand how this can be used to solve higher-order linear equations,
- use infinite series expansions to solve certain linear ODEs with variable coefficients,
- use Laplace transforms to solve linear ODEs with discontinuous terms,
- use basic numerical solution techniques for ODEs and appreciate common sources and magnitude of error, and
- Obtain qualitative information about solutions of ODEs using the phase plane.

Course Requirements

Attendance

You are expected to attend class and will be responsible for what transpires in class regardless of your attendance. As a courtesy to others, please **avoid arriving late** and **do not leave during class** unless it is an emergency or you have made prior arrangements with me. Each student is allowed six (6) absences

during the term for whatever reason. In general, for each absence after the sixth you should expect a five percent (5%) reduction in the final average. If you are aware of classes you will need to miss because of field trips, athletic events, or for personal reasons, plan to include those among your allowed absences.

Homework Assignments

Homework will be due at the start of each class period. The following are required of all assignments:

- Assignments are to be done on 8.5×11 paper.
- Pages must not have ragged edges from spiral bound notebooks.
- Solutions should be laid out in an organized, legible manner and presented in the order that they were assigned.
- Final answers should be clearly marked, either by highlighting or by enclosing in a neat circle or box (where appropriate).
- Multiple page assignments must be fastened together.

While some of the exercises will have short, easy-to-compute answers, some will take a good deal of effort and space to present the solution. It may be helpful to first work out problems on scrap paper, trying different approaches until you find one that leads to a solution, before writing out your solution.

You are permitted to discuss homework problems with others in the class. However, the work you turn in should be your own. These problems should be considered tools to help you better understand the theory and to become more proficient with the techniques of this course. *It is essential that you understand the solution to each problem in order to derive the greatest benefit from this course.*

Projects

Two team projects will be assigned during the semester. These projects will provide you with some basic research and mathematical writing experience and to allow you to examine some aspects of the study of differential equations that will not be covered in detail during the class lectures.

Examinations

There will be two exams during the term and a cumulative final exam.

Procedure and Expectations

Class time will be devoted to lectures and discussion but I may ask you to perform some work during our class meeting times. You are encouraged to ask questions during class. *You are expected to have read the sections which will be discussed in class prior to the class meeting*. **I expect that during class you will not use your cell phone, tablet or laptop for non-class related conversations or activities.** These activities prevent you from fully concentrating on our topic and they are often distracting to those around you.

For each semester hour of credit, students should expect to spend a minimum of 2–3 hours per week outside of class in engaged academic time. This time includes reading, writing, studying, completing assignments, lab work, or group projects, among other activities.

Grading Procedure

Your final average will be computed using the following table:

Component	***Percentage***	***Component***	***Percentage***
Participation	5%	Exam 1	15%
Homework	35%	Exam 2	15%
Projects	15%	Final	15%

The following table shows the correspondence between the final average and letter grades.

[100 – 97]	A+	(90 – 87]	B+	(80 – 77]	C+	(70 – 67]	D+
(97 – 94]	A	(87 – 84]	B	(77 – 74]	C	(67 – 64]	D
(94 – 90]	A–	(84 – 80]	B–	(74 – 70]	C–	(64 – 60]	D–

Tentative Schedule

Day	**Date**	***Topic* and Assignment Due**
Wednesday	January 15	*Introduction*
Friday	January 17	*2.1 Linear Equations with Variable Coefficients* 1.1: 1, 2, 3, 4, 5, 6, 7 1.2: 1 (parts a, b, and c), 3, 13
Monday	January 20	*Martin Luther King Jr. Birthday*
Wednesday	January 22	*2.2 Separable Equations* 1.3: 1, 2, 3, 4, 5, 6, 8, 12, 16 2.1: 1, 2, 5, 19, 20, 30
Friday	January 24	*2.3 Modeling with First Order Equations* 2.2: 3, 5, 7, 16, 21
Monday	January 27	*2.3 Modeling with First Order Equations (continued)* 2.3: 3, 9, 13
Wednesday	January 29	*2.4 Differences between Linear and Nonlinear Equations* 2.3: 4, 16, 18, 19
Friday	January 31	*2.5 Autonomous Equations and Population Dynamics* 2.4: 3, 5, 10, 13, 25
Monday	February 3	*2.6 Exact Equations and Integrating Factors* 2.5: 2, 3, 15, 20, 22
Wednesday	February 5	*3.1 Homogeneous Differential Equations with Constant Coefficients* 2.6: 2, 3, 9, 15
Friday	February 7	*3.2 Solutions of Linear Homogeneous Differential. Eqs; the Wronskian* 3.1: 2, 7, 13, 17, 23

Day	**Date**	***Topic* and Assignment Due**
Monday	February 10	*3.3 Complex Roots of the Characteristic Equation* 3.2: 4, 7, 9, 14, 18, 29
Wednesday	February 12	*3.4 Repeated Roots; Reduction of Order* 3.3: 2, 4, 10, 18, 25, 29
Friday	February 14	*3.5 Nonhomogeneous Differential Eqs: Undetermined Coefficients* 3.4: 5, 10, 12, 18
Monday	February 17	*3.6 Variation of Parameters* 3.5: 2, 12, 15, 31
Wednesday	February 19	*4.1 General Theory of n^{th} Order Linear Differential Equations* 3.6: 5, 14
Friday	**February 21**	**Exam 1: Chapters 2 & 3**
Monday	February 24	*4.2 Homogeneous Differential Equations with Constant Coefficients* 4.1: 2, 6, 9, 16, 19
Wednesday	February 26	*4.3 The Method of Undetermined Coefficients* 4.2: 1, 3, 5, 7, 8, 14
Friday	February 28	*6.1 Definition of Laplace Transform* 4.3: 1, 2
Monday	March 2	*6.2 Solution of Initial Value Problems* 6.1: 2, 5, 30
Wednesday	March 4	*6.3 Step Functions* 6.2: 2, 4, 10, 14, 20, 29
Friday–Friday	March 6-13	***Quad Finals & Spring Break***
Monday	March 16	*(Reset day)*
Wednesday	March 18	*6.4 Differential Equations with Discontinuous Forcing Functions*
Friday	March 20	*6.5 Impulse Functions*
Monday	March 23	*7.1 Introduction to Systems of 1st Order Differential Equations*
Wednesday	March 25	*7.2 Review of Matrices*
Friday	March 27	*7.3 Systems of Equations, Eigenvalues and Eigenvectors*
Monday	March 30	*7.4 Basic Theory of Systems of First Order Linear Equations*
Wednesday	April 1	*7.5 Homogeneous Linear Systems with Constant Coefficients*
Friday	April 3	*7.6 Complex Eigenvalues*
Monday	April 6	*7.8 Repeated Eigenvalues*
Wednesday	**April 8**	*Exam 2*

Day	**Date**	***Topic* and Assignment Due**
Friday	April 10	*Good Friday*
Monday	April 13	*Easter Monday*
Wednesday	April 15	*9.1 The Phase Plane: Linear Systems*
Friday	April 17	*9.2 Autonomous Systems and Stability*
Monday	April 20	*9.3 Locally Linear Systems*
Wednesday	April 22	*9.4 Competing Species*
Friday	April 24	*9.5 Predator-Prey Equations*
Monday	April 27	*5.1 Review of Power Series*
Wednesday	April 29	*5.2 Series Solution near an Ordinary Point, Part I*
Friday	May 1	*5.3 Series Solution near an Ordinary Point, Part II*
Monday	May 4	*5.4 Euler Equations; Regular Singular Points*
Wednesday	May 6	*5.5 Series Solutions near a Regular Singular Point, Part I*
Monday	May 11	**Final exam: 9:00–11:00 a.m.**