GOSHEN COLLEGE
MATHEMATICS DEPARTMENT
MATH 321 DIFFERENTIAL EQUATIONS – FALL 2020-21

Motivation	The study of differential equations and the calculus originated with the work of Isaac Newton and Gottfried Wilhelm Leibnitz. The development of these theories is considered one of the major intellectual achievements of the seventeenth century. The theories were developed in order to explain the physical motion of objects. Since that time, differential equations have been used to explain and predict the course of chemical reactions, animal populations, radioactive decay, military arms races, economic growth, the spread of diseases and rumors, and more. The techniques of differential equations are standard tools for engineers, physical scientists, and applied mathematicians.
Catalog Description	The solution and application of ordinary differential equations; analytic solutions for linear systems; qualitative behavior of nonlinear systems; approximation and computer methods.
Learning Objectives	Students will obtain the ability to (1) create and critique differential equation models of a variety of natural phenomena, (2) solve ordinary differential equations using qualitative, analytic, and numeric techniques, and (3) interpret solutions of ordinary differential equations. At a higher level, each student will improve her or his ability to solve problems, communicate clearly and precisely, learn from a variety of resources, utilize technology, and appreciate the applicability of mathematics.
Prerequisite	Math 211 Calculus I provides sufficient calculus background to be successful in this course; however, this upper-level mathematics course also requires a higher degree of mathematical maturity, which may be acquired in other courses such as Math 205 Discrete Mathematics or Math 213 Calculus II. You will be asked to assimilate new mathematical and computational concepts and techniques at a deeper level than in your earlier mathematics courses.
Instructor	David Housman, SC 117, dhousman@goshen.edu, 574-535-7405. Office hours will be posted on Moodle and office door.
Class	MWF 1:00 – 1:50 AM in SC 203. Attendance and participation are expected. For students who are unable to attend class in person for legitimate reasons, remote participation via Zoom or a video equivalent will be available. A recording of the Zoom class session or the video equivalent will be available for any student to watch. Class activities will complement, not substitute, for the reading, problem solving, and concept discussing students engage in outside of class.
Text & Software	*Differential Equations, Fourth Edition* by Paul Blanchard, Robert L. Devaney, and Glen R. Hall, Brooks/Cole Cengage Learning, 2012, Print ISBN: 9780005377185, eText ISBN: 9781133388081. The DE Tools software that may come bundled with the text is useful but optional. We will rely on freely available software as needed.
On-line	Moodle (https://moodle.goshen.edu) and CoCalc (https://cocalc.com).
Grading	Grades will depend upon your performance on assignments, labs, and two comprehensive exams. Each of these three components will be weighted equally. Numerical scores will be assigned with the following interpretation: 20 for A+, 19 for A, 18 for A-, 17 for B+, 16 for B, 15 for B-, and so forth. Some upward adjustment may be made based upon class participation and individual effort.
Assignments	Exercises assigned will test your ability to solve problems like those presented in class and the text. Each student will turn in a complete set of solutions on paper or a pdf document uploaded in Moodle. If computer software is used to obtain an answer, include an organized print out of the computations performed. An assignment containing correct solutions with complete explanations will earn full credit.

Extra Credit

Receive extra credit toward your assignments grade by doing one or more of the following: (1) find errors in the text or posted course materials and describe the error in writing; (2) attend a quantitative presentation (e.g., Science Speakers) or participate in a quantitatively based activity and describe in writing some interesting mathematical aspect of the presentation or activity; or (3) participate in a Career Services event and describe your most important discovery. For any of these activities, the description should be two or three substantive paragraphs and be submitted to the instructor. For a 50-minute Science Speakers presentation, up to 3 points can be earned.

Labs

A lab is a more open-ended and complex exploration of mathematical ideas, often involving a real-world application. The labs assigned should help you synthesize and apply course concepts and techniques. Six laboratories will be assigned with Lab5 being optional extra credit. Each lab may be completed by groups of one to three students. The report should be typewritten, organized, and independent of the textbook lab description. If software is used to obtain an answer, include an organized print out of the computations performed (perhaps as an appendix). Complete and correct solutions with clear and concise explanations will earn a B-level grade. An A-level grade requires going beyond the problem as stated in terms of techniques applied, insights communicated, or creativity.

Exams

Exhibit your ability to use differential equation concepts and techniques in well-defined contexts and without assistance or collaboration. Think of the midterm exam (worth 1/3) as a practice for the final exam (worth 2/3) because the final exam grade, if higher, will replace your midterm exam grade.

Due Date Policy

Assignments, laboratories, and exams can only be rescheduled or made up if (1) there is a serious medical problem, a death in the immediate family, or an irreconcilable conflict with another official Goshen College activity; (2) there is written documentation signed by proper authorities; and (3) the instructor is notified prior to the due date or as soon as possible afterwards.

Disability and Tutoring Services

Goshen College is committed to providing all students equal access to programs and facilities. Students who need accommodations based on disability should contact the Director of the Academic Success Center (ASC). Students must register with ASC before faculty are required to provide reasonable accommodations. For more information or to register, please contact the Director of the ASC, Judy Weaver, Good Library 112, jweaver@goshen.edu or 574-535-7560. To ensure that learning needs are met, contact the director of the ASC the first week of classes. Individual tutoring can be scheduled at tutorcal.goshen.edu.

Course Materials are for Private Use

Course materials (videos, assignments, exams, problem sets, etc) are for use in this course only. You may not upload them to external sites, share with any person outside this course, or post for public commentary without written permission from the professor. Sharing recordings outside of the class could lead to a copyright or FERPA violation. Goshen College prohibits any student from duplicating, downloading, or distributing class recordings with anyone outside of this class, for any reason.

Collaboration and Academic Integrity

You are encouraged to use all available resources to learn the concepts and techniques discussed in this course. Conversations with other students and the instructor can be an effective learning method. Reading other books and web pages can be another effective learning method. However, copying someone else's work subverts the learning process.

For assignments and laboratories, you may look at and discuss another student's work, but any written work developed during collaboration with another student should be destroyed before writing your own solutions. You should give written acknowledgement to people with whom you have had discussions and to any written materials (other than the text) that were helpful.

For exams, you may *not* use any resources unless a specific exception is stated by the instructor.

Failure to observe the above rules will result in a zero on the assignment, laboratory, or exam. Any violation of academic integrity will be reported to the Associate Dean.

Observation of the above rules will help you learn the material well and give you the satisfaction of knowing that you have earned your grade.

Structure

We will usually cover two or three sections in the text every week or so (see the tentative schedule below). Depending upon your learning style, you may read the text in preparation for class and/or use the class as an introduction to the reading. Homework exercises should be completed individually as much as possible and then compared with answers found in the text and solutions that are posted on Moodle. On the class day we start a new topic, I will answer questions pertaining to the topic just completed, and then assignments will be due at the beginning of the next class.

	Class 1	Class 2	Class 3	Class 4	Class 5
Topic x	Questions	Assignment due			
Topic y	Lecture	Lecture	Lecture	Questions	Assignment due
Topic z				Lecture	Lecture

I urge you to complete as much of the assignment as possible by the Questions class. This will allow you to ask the most helpful questions and keep you from falling behind with the new material.

Tentative Schedule

The table shows the sections of the text I currently plan to cover and the laboratories that will be due during the class dates shown. In previous offerings of this course, there were 40 class days, and this time there are only 39 class days. The current plan is to shortchange the last topic. The Moodle course page may be updated as the semester progresses.

N	Topic	Class Dates	Text	Labs
1	Introduction	Aug 19, 21	1.1-2	
2	First-Order Equations	Aug 24, 26, 28	1.3-5	
3	First-Order Equations	Aug 31, Sep 2, 4	1.6-8	Lab 1.1 or 1.2
4	First-Order Systems	Sep 7, 9, 11, 14	2.1-6	
5	Linear Systems	Sep 16, 18, 21, 23	3.1-3	Lab 1.3, 1.4, or 1.5
6	Linear Systems	Sep 25, 28, Oct 2, 5	3.4-5	
7	Linear Systems	Oct 7, 9, 12	3.6-7	Lab 2.1, 2.3, 2.4, or 2.5
		Oct 14	In-class Midterm Exam	
8	Forcing and Resonance	Oct 16, 19, 21	4.1-3	
9	Forcing and Resonance	Oct 23, 26, 28	4.4-5	Lab 3.1, 3.2, 3.3, or 3.6
10	Nonlinear Systems	Oct 30, Nov 2, 4	5.1-3	
11	Nonlinear Systems	Nov 6, 9, 11, 13	5.3-6	Lab 4.1 or 4.3
12	Discrete Systems	Nov 16, 18	8.1-4	Lab 5.1, 5.2, 5.3, or 5.4
13	LaPlace Transforms	(optional independent)	6.1-4	
		Nov 23, 3:30-5:30pm	Comprehensive Final Exam	