Math 214 – Elementary Differential Equations – Spring 2022

Dates/Times TR 3:00-4:15

Textbook *Elementary Differential Equations and Boundary Value Problems*, 11th edition, Boyce DiPrima and Meade, Wiley.

Instructor Matt Holzer, mholzer@gmu.edu

Office Hours TBA

Recitation Instructor Jackson Williams jwill52@gmu.edu, Office Hours TBA

Course Description Differential equations are essential tools in the modeling of many phenomena. This course is an introduction to differential equations. We will cover topics from Chapters 1-3 and 6-7. This includes modeling using first and second order equations, linear systems, resonance and Laplace Transforms.

Prerequisites Grade of C or better in MATH 213 or 215.

Important Dates

Thursday May 12th: Final Synthesis Exam (1:30-4:15)

Standards Based Grading This course will use a version of standard based grading. In this system a grade will be assigned at the end of the semester that reflects how many of the desired learning outcomes that you have mastered. A list of these standards is provided below.

Standards based grading attempts to align the end of semester grade with demonstrated proficiency with the learning outcomes of the course (listed below). My goal is to work with you to ensure that you achieve the grade that your desire in this class and, concurrently, that you become proficient with the subject matter to an analogous degree. One key aspect of standards based grading is the opportunity to re-take assessments. This is typically popular with students as it (somewhat) eases the stress associated to any one assessment and does not penalize a student for a poor exam performance early in the semester. An appealing aspect of standards based grading from a faculty perspective is that partial credit is (typically) not awarded. Therefore, to pass a standard you must actually show that you know what you are doing instead of relying on partial credit to buoy your grade.

Standards Days During "Standards Days" students will have the opportunity to select which standards they wish to be tested on. To demonstrate mastery of the standard, the problem or problems must be solved correctly with clearly written explanations of each step. If this is accomplished, then the standard is marked as having been met. If the answer or reasoning is incorrect, then you are able to attempt the standard again at a later date.

Numbers that appear in Blackboad are code. A designation of 20 is given to a correctly answered (and therefore passed standard). The number one will be used to indicate that you attempted, but were not successful, in passing the standard. Typically, you are required to pass all parts of all problems on the standard to pass. Occasionally, I will place a mark of 10 to indicate that almost all of the standard was done correctly indicating significant proficiency with the learning objective, but something was incorrect. One such "partial pass" will be allowed to count as a pass in the final grade tabulations (see recitation below). Please note that these numbers are not scores and so adding or averaging them does not contain any useful information.

Synthesis Exam During the Final Exam period, students will be asked to demonstrate the knowledge that they have gained throughout the semester. This six question exam will be scored as a traditional exam would be with partial credit awarded.

Recitation Recitation will be used as a problem solving session guided by the TA, Jackson Williams. Attendence is encouraged by not required. A student who attends 10 recitations throughout the semester will be allowed to count a second "partial pass" as a full pass in the final grades.

Grades Grades will be assigned based upon how many standards are met through the term in combination with how you perform on the Synthesis Exam

Standards Met	Pre Synthesis Grade
17	A
16	A-
15	B+
14	B
13	B-
12	C+
11	C
9-10	D
less than 9	F

Final Exam Score	Grade Adjustment
> 5.5	one half grade higher than standards grade
4.5 -5.5	standards grade
3.5-4.5	one half grade lower than standards grade
< 3.5	two half grades lower than standards grade

Standards

1. ODE basics and direction fields: solutions of ordinary differential equations and initial value problems and approximations using direction fields. (Chapter 1 and Section 2.1)

2. Integrating Factors: demonstrate the ability to solve differential equations and initial value problems using the method of integrating factors. (Section 2.1)

3. Separation of Variables: demonstrate the ability to solve differential equations and initial value problems using this technique. (Section 2.2)

4. Modeling with ODEs: given a list of assumptions the student should be able to formulate a differential equation which describes the system of interest. Given a differential equation, then the student should be able to interpret the differential equation to understand what assumptions might be underlying the system. (Section 1.1, 2.3, 2.5 and others)

5. Equilibrium and Autonomous First Order Equations. Be able to identify equilibrium points, classify their stability and draw approximate solutions curves. (Section 2.5)

6. Theoretical aspects of second order linear equations: linear superposition, Wronskians, Abel's Theorem, Variation of Parameters and particular solutions. (Sections 3.1, 3.2, 3.5)

7. Second order homogeneous equations: be able to write down solutions for constant coefficient second order equations with real eigenvalues. (Section 3.1)

8. Second order homogeneous equations: be able to write down solutions for constant coefficient second order equations with complex or repeated eigenvalues. (Sections 3.3 and 3.4)

9. Qualitative Solution Features from Eigenvalues: understand what information can be gleaned about the solution of a differential equation from its eigenvalue. (Chapter 3 various sections)

10. The Damped Mass-Spring System: understand the concepts of underdamped, overdamped and critically damped and relation to their solution features. (Sections 3.7 and 3.8)

11. Forced Second Order Equations : demonstrate the ability to write down solutions of constant coefficient second order equations with non-homogeneous forcing terms. (Sections 3.6, 3.7 and 3.8)

12. Resonance: understand the importance of resonance to applications and be able to identify resonance in a variety of systems. (Section 3.8)

13. Laplace Transforms (Basics): understand what the Laplace Transform is and be able to apply it to solve linear non-homogeneous differential equations. (Sections 6.1 and 6.2)

14. Laplace Transforms with Discontinuous forcing functions: demonstrate the ability to analyze differential equations with discontinuous forcing using Laplace Transforms (Section 6.3 and 6.4)

15. Impulse Forcing: demonstrate the ability to analyze differential equations with impulsive forcing using Laplace Transforms. (Sections 6.3, 6.5)

16. Linear Systems with real eigenvalues: the student should be able to write down general solutions or solutions of initial value problems for systems of coupled equations by computing eigenvalues and eigenvectors (two by two matricies only). Student should also be able to draw phase portraits for these systems. (Section 7.5)

17. Linear Systems with complex eigenvalues: the student should be able to write down general solutions or solutions of initial value problems for systems of coupled equations by computing (complex) eigenvalues and eigenvectors. Student should also be able to draw phase portraits for these systems. (Section 7.6)

COVID-19 All students taking courses with a face-to-face component are required to follow the university's public health and safety precautions and procedures outlined on the university Safe Return to Campus webpage (https://www2.gmu.edu/safe-return-campus). Similarly, all students in face-to-face and hybrid courses must also complete the Mason COVID Health Check daily, seven days a week. The COVID Health Check system uses a color code system and students will receive either a Green, Yellow, Red, or Blue email response. Only students who receive a "green" notification are permitted to attend courses with a face-to-face component. If you suspect that you are sick or have been directed to self-isolate, please quarantine or get testing. Faculty are allowed to ask you to show them that you have received a Green email and are thereby permitted to be in class. Students are required to follow Mason's current policy about facemask-wearing. As of August 11, 2021, all community members are required to wear a facemask in all indoor settings, including classrooms. An appropriate facemask must cover your nose and mouth at all times in our classroom. If this policy changes, you will be informed; however, students who prefer to wear masks either temporarily or consistently will always be welcome in the classroom.
Academic Integrity You are bound by the Mason Honor Code and its policies related to Academic Integrity. Violations will be taken seriously. The minimal sanction for minor honor code violation is the requirement to re-take all standards. More severe violations will lead to an automatic F grade in the course.

Disability Services Students may be eligible for accommodations through the Office of Disability Services

Communication All email communication is to take place through your gmu email account.