Math 214 – Elementary Differential Equations – Fall 2020

Dates/Times MW 12:00-1:15 Online

Recitation Instructor Joseph Frias, jfrias3@masonlive.gmu.edu

Textbook *Differential Equations*, 4th edition, Blanchard Devaney and Hall, Brooks-Cole.

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Office Hours W 10-11 for open (online) office hours and F 10-11 for appointment hours.

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 1-4 and 6. 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

Monday September 7th : Labor Day (no class)
Monday October 12th: Columbus Day (no class)
Tuesday October 13th: Monday class is held on Tuesday this week
Wednesday November 25th: Thanksgiving Holiday (no class)

Course Structure The lecture material for this course will be delivered *asynchronously*, meaning that I will be posting a sequence of videos on Blackboard. Accompanying these videos will be homework assignments. It is expected that you watch the videos and complete the associated homework assignments including reading of the textbook. Although these assignments will not be handed in or graded, you will have an opportunity to discuss them in recitation and it is important that you complete them to be successful in the course.

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.

There will be many (many!) assessments this semester (although no midterms or final exams) and so to be successful you must work diligently each week to watch all lecture materials, attempt all homework problems and prepare for each week's assessments.

Standards Day (Monday) During the 12:00-1:15 time frame on Mondays 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.

In Gradescope, a mark of 5 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. The number zero will show that you did not attempt 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 4 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. Please note that these numbers are not scores and so adding or averaging them does not contain any useful information. (For example, failing a standard 5 times does not equal passing it once).

Synthesis Day (Wednesday) Each Wednesday a synthesis question will be asked that covering some subset of the material discussed to that point of the class. These will be similar to standards questions, but you will not know exactly which section is being covered. These questions will be scored out of one point on a quarter point scale. I expect there to be 13 of these questions.

Assessment Format All assessments will be facilitated through Gradescope. Each Monday you will log onto the system during the time frame of 12-1:15 and attempt as many standards as you wish. You will upload a pdf copy of your work. A limited amount of time will be allowed for each problem. On Wednesday, typically one Synthesis question will be available for a limited period of time starting at 12:15. You are again expected to upload a pdf copy of your work.

Assessment Policies The following policies apply to the standards and synthesis assessments.

- You may consult your own, handwritten notes
- All assessments are *closed* book
- You may not consult any resources during assessments aside from your handwritten notes. That means you may not use any internet resource or advice of other students/friends/family/tutors.
- You must *attempt* each standard within the first three times that it is offered

Final Exam There is no final exam for this class.

Grades Grades will be assigned based upon how many standards are met through the term in combination with the number of Synthesis questions answered correctly.

Standards Met + Synthesis Points	Grade
30 or more	A
29	A-
28	B+
27	B
26	B-
25	C+
23-24	C
20-24	D
less than 20	F

Standards

0. Calculus Review and Gradescope Familiarity. Learn how to submit standard answers on gradescope using a pdf converter and show that you remember how to differentiate and integrate some functions from Calculus I/II.
1. Separation of Variables: demonstrate the ability to solve differential equations and initial value problems using this technique. See Section 1.2.
2. Slope Fields and Existence and Uniqueness Theorem: Use slope fields to glean qualitative information regarding solutions to ODEs and apply the E+U Theorem. See Section 1.3 and 1.5.
3. Equilibrium and Phase Lines: know what an equilibrium point is and be able to classify them as sinks/sources/nodes. Student should be able to draw phase lines to extract qualitative description of the system dynamics. See Section 1.6

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. See Sections 1.1 and 2.1 among others.

5. Bifurcations: understand the role of parameters in differential equations and understand when small changes in parameters lead to large changes in the qualitative behavior of the system. Demonstrate knowledge by drawing bifurcation diagrams. See Section 1.7.

6. Integrating Factors: demonstrate the ability to solve differential equations and initial value problems using the method of integrating factors. See Sections 1.8 and 1.9.

7. Linearity Principle: understand the importance of linearity in the study of differential equations and demonstrate an understanding of the linearity principle and extended linearity principle. See Sections 1.8, 1.9, 3.1 and 4.1.

8. 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. Student should also be able to draw phase portraits for these systems. See Section 3.2 and 3.3.

9. 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. See Section 3.4.

10. Linear Systems with repeated or zero 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. Student should also be able to draw phase portraits for these systems. See Section 3.5.

11. Second order homogeneous equations: be able to write down solutions of second order equations. See Section 3.6.

12. Qualitative Solution Features from Eigenvalues: understand what information can be gleaned about the solution of a differential equation from its eigenvalue. See Chapter 3.

13. Trace Determinant Plane and Classification of Equilibrium Points: be able to classify equilibrium points as sinks/sources/saddles/centers/other by using the trace determinant plane. See Section 3.7 and rest of Chapter 3.

14. The Damped Mass-Spring System: understand the concepts of underdamped, overdamped and critically damped and relation to their solution features. See Section 2.3 and much of Chapter 3.

15. Forced Second Order Equations (exponential forcing): demonstrate the ability to write down solutions to first or second order equations with exponential forcing. See Section 4.1.

16. Forced Second Order Equations (sinusoidal forcing): demonstrate the ability to write down solutions to first or second order equations with sinusoidal forcing. See Section 4.2.

17. Resonance: understand the importance of resonance to applications and be able to identify resonance in a variety of systems. See Section 4.3.

18. Laplace Transforms (Basics): understand what the Laplace Transform is and be able to apply it to solve linear inhomogeneous differential equations. See Section 6.1 and 6.3.

19. Delta function and Impulse Forcing: demonstrate the ability to analyze differential equations with discontinuous or impulsive forcing using Laplace Transforms. See Section 6.2 and 6.4.

Technology Requirements You will need a laptop or other device to access Blackboard, the lecture material and homework. For assessments you will need a phone with picture taking capability to scan your answers and submit them as pdfs.

Academic Integrity You are bound by the Mason Honor Code and its policies related to Academic Integrity. Violations will be taken seriously. All assessments in this course (standards and synthesis) are to be completed on your own and without assistance from other persons or materials (excluding your own handwritten notes). 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.

Recording and Sharing of Class Materials You may not share or upload any class materials (videos, homeworks or assessments). Doing so constitutes a violation of the Mason Honor Code.

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.