MERCYHURST UNIVERSITY

MATH 240 – Differential Equations

COURSE SYLLABUS · SPRING 2021

INSTRUCTOR:	Roger Griffiths	**OFFICE HOURS:**	
OFFICE:	Old Main 305		Mon: 10:00 - 10:50
EMAIL:	rgriffiths@mercyhurst.edu		Tues: 12:00 - 1:50
PHONE:	824-2123		Wed: 12:00 - 12:45
CLASS TIME:	Mon, Wed, Fri: 09:00 - 09:50 (3 semester credits)		Wed: 3:00 - 3:50
LOCATION:	Hirt 209		Thur: 09:00 - 09:50
WEB:	www.integral-domain.org/rgriffiths/courses/m240/		
TEXT:	*Fundamentals of Differential Equations*, (8th Edition)		
	by Nagle, Saff, Snider		

Learning Objectives

In this course you will learn introductory mathematical content of ordinary differential equations and their applications. This will include analytical, qualitative and numerical methods for ordinary differential equations.

Prior to calculus, we used our understanding of the rules of algebra to develop techniques for solving algebraic equations. In this class we will use both the rules of algebra and the rules of calculus (e.g., differentiation shortcuts, integration techniques, etc.) to develop techniques for solving differential equations. We will continue to improve our ability to *write mathematics*.

Why?

The major application of calculus is posing, solving, and understanding solutions of differential equations. Because many laws of nature are equations involving rates at which quantities change, this idea is a derivative, and equations containing derivatives are differential equations. So, in order to understand the many processes of change in the world, one needs to understand differential equations.

Textbook

Fundamentals of Differential Equations, by Nagle, Saff, Snider, 8th Edition. You will need this textbook, and be sure to check the edition when purchasing; other editions have similar material, but the assigned problems may be different. Other then a lot of notebook paper and pencils, no other materials are required for this class. You do NOT need to purchase a subscription to MyMathLab or pay to access any other online resources. If you prefer to purchase an electronic version of the text, you're welcome to do so.

Class Meetings

Due to the number of students in this class we will be able to meet in-person everyday (in our class room). This class will not meet *virtually* unless mandated by health authorities or the university; we will attempt to follow a pre-COVID in-class routine.

COVID-19 Prevention and Policies

Due to the uncertainty surrounding this semester and the need to maintain safe conditions for our class and the Mercyhurst community, the University has implemented a number of policies. Below I list both the University policies (in italics) as well as specific policies for our class.

Face Masks

As per the COVID-19 Prevention, Mitigation, and Response Policy, Mercyhurst University is requiring that all members of the campus community wear a cloth or disposable face covering over their nose and mouth when on campus. Please refer to the policy for specific details as to where and when face coverings are required. Students may use their own face coverings or those provided by the University. A student in need of a face covering should email covid19@mercyhurst.edu or call 814-824-3600 to find the nearest location where face coverings are available. The University's Mask/Face Coverings Policy will be enforced in this class.

Sanitation and Safety

In keeping with the COVID-19 Prevention, Mitigation, and Response Policy, students are expected to use hand sanitizer and to wipe down their desks using disinfectant wipes when they enter and exit the classroom. Classrooms have been provided with sanitizer and disinfectant wipes for student and faculty use.

Eating and Drinking in the Classroom

In light of the COVID-19 situation, Eating is not permitted in classrooms, labs, or other academic spaces. A water bottle or cup with a lid, and straw preferably, is permitted to be used in classrooms and labs to help prevent a student from becoming uncomfortably parched. Masks should be pulled only slightly away from the bottom of the face to take a quick drink and immediately replaced to covering the mouth and nose.

Class Dismissal, Congestion Prevention

In keeping with the COVID-19 Prevention, Mitigation, and Response Policy, faculty members and students should take steps to avoid crowding outside of classrooms, in hallways, and any enclosed area in university buildings. All rooms will be designated with signs indicating maximum capacity for specific instructional use. These must always be adhered to. Students waiting to enter classrooms or exiting classrooms should always maintain a minimum of 6 feet of distance from others. Class time endings may be adjusted when necessary to minimize overcrowding or congestion.

Seating Chart

In compliance with federal and state regulations, the University must be able to conduct contact tracing if there is a positive test or an outbreak; therefore, seating charts are mandatory for all in-person classes. Students will be required to sit in the same seat in the classroom each time they attend class. The seating chart will be available for review for purposes of contact tracing.

Attendance and Missed Class

If you have a fever, shortness of breath or difficulty breathing, new loss of taste or smell, cough, or feel sick at all, please do not come to our classroom. In that case, if you wish to participate in class utilize the streamed class via Blackboard/Zoom. Your health and the health of the Mercyhurst community is the first priority.

Attendance at all classes is expected. However, it is important that students and course instructors adhere to the university's COVID-19 mitigation policies and strategies. As such, a student who misses class due to illness or suspected illness within the context of those policies will not be penalized and will be provided sufficient means to make up any missed course content or work and remain actively engaged in the class.

Resume Syllabus

Calculators and Computers

You may use a calculator/computer to help learn the material, but **you will not be permitted to use a calculator or computer on any exam**.

There are several portions of the class that will require the use of a computer, however, all of our examinations are carefully designed to be taken "closed book" without the use of calculators or computers. Examination problems will focus on the basic methods and problem solving techniques which every student of differential equations must know without a calculator or textbook. This policy reinforces our stated learning objectives, in particular, furthering our understanding of the language of mathematics. We will be interested in learning and writing mathematics (the process) not in 'the answer'.

Homework

I do not collect or grade your written homework. You will be held accountable for the mastery of homework problems via the exams.

Homework Suggestions

- **Homework is far and away the single most important part of any mathematics course** because this is when most (all) of the learning takes place.
- In studying mathematics, you must be careful not to let a tutor or friend *think* for you. It is essential that you can work problems **completely on your own, without help from any resource,** by the time of an exam.
- This 'PRACTICE' is how you master the material, you will want to practice in the manner you will be accessed. That means *write mathematics*, your focus should not be on 'the correct answer', but rather, what you write as your solution.

Evaluation

The exact details for evaluation will depend on changes in course delivery due to COVID.

Exams: If we remain in-person:

- There will be four exams given throughout the semester, in class.
- We will have a cumulative final exam during finals week, in class.
- Students are required to take all exams at the scheduled hour as they appear on the syllabus and course schedule.
- There will be no late '*make-up*' exams, as this is unfair to the rest of the class. If you know in advance you are going to miss a scheduled exam, let me know well in advance of the exam.
- A missed exam will result in the final exam being worth 300 points (you do not loose any points for the missed exam, those points simply roll into the final exam). A second missed exam will receive a grade of 0 (zero).
- Our goal is not simply a 'correct answer'. But rather, you are to demonstrate the extent to which you understand each problem, this means *write mathematics*. A good write-up includes: connecting your work, proper notation, and an explanation of steps as you see necessary.

Evaluation - Remain In Person

Your letter grade in this course will be based on:

- 400 points: **Exams** 4 exams at 100 points each
- 200 points: **Final Exam** Comprehensive Final exam worth 200 points

600 points: **Total points** in the course

Grading Scale - Remain In Person

Letter Grade	A	B+	B	C+	C	D
Total Class Points	540	522	480	462	420	360
Percent	90%	87%	80%	77%	70%	60%

Exams: If We Move to Virtual Delivery:

- We will have the four exams during the semester, but there will Not be a Final Exam.
- There will be no late exams. If you miss an exam, the grade for that missed exam will be replaced at the end of the semester by your average on the other three exams. A second missed exam will receive a grade of 0 (zero).

Evaluation - Virtual Delivery

If we move to virtual delivery, your letter grade in this course will be based on:

- 400 points: **Exams** 4 exams at 100 points each (total points in the course)

Grading Scale - Virtual Delivery

Letter Grade	A	B+	B	C+	C	D
Total Class Points	360	340	320	308	280	240
Percent	90%	87%	80%	77%	70%	60%

✓ Your overall performance in the course is measured by the total number of points you accumulate relative to the maximum points possible. Your letter grade in this course will be based on the distribution above, the standard scale used in the Mathematics and Information Technology department.

✓ These are the only points possible in this class, there is no extra credit (or 'make up'), your asking for extra credit is a clear indication that you have not read this syllabus, which you should think of as 'your class contract'.

Course Policies

- ✓ You are responsible for all that is announced or covered in class even if you are absent.
- ✓ You are responsible for all the material in a given section unless told otherwise, use the course schedule and suggested homework as a guide.
- ✓ A prerequisite for additional help outside the classroom is regular class attendance.
- ✓ Every student is required to establish a *class contact*, that is, a fellow classmate that you may contact in case you are having a problem with a particular homework exercise at night/weekend or in the event you miss class, you can get the class notes from them.
- ✓ If you miss class, you are responsible for getting the notes from your 'class contact' (see above).
- ✓ Email is great for **simple** communications, but more complex issues must be handled in office hours.
- ✓ I expect you to read this syllabus and get clarification of any items you do not understand the first week of class. After that, if you send me an email asking me about something covered in this syllabus, that email will likely be disregarded.

University Resources and Policies

ADA Accommodations/Academic Support

Mercyhurst University is committed to making reasonable accommodations for qualified students, and employees with disabilities as required by law. Please refer to the HUB: https://lakersmercyhurst.sharepoint.com/sites/StudentsHub and select the Services tab, then ADA Accommodations from the dropdown for instructions to request an accommodation. You may also contact Susan Reddinger, ADA Coordinator, ADA@mercyhurst.edu, 814-824-2362, Egan Hall 200.
For students with questions about Academic Support, please refer to the HUB: https://lakersmercyhurst.sharepoint.com/sites/StudentsHub and select the Academic Resources tab, then Academic Support for more information.

TITLE IX Sexual Misconduct/Sexual Harassment Reporting

Mercyhurst is committed to providing an environment free from sex discrimination, including sexual harassment and sexual violence. Please refer to the HUB https://lakersmercyhurst.sharepoint.com/sites/StudentsHub and select the Resources tab, then Title IX – Sexual Respect from the dropdown for more information. If you would like to file a sexual misconduct complaint, please contact Dr. Laura Zirkle, Interim Title IX Coordinator and VP for Student Life, titleix@mercyhurst.edu, 814-824-2362, Egan Hall 314. Please be aware that in compliance with Title IX, educators must report incidents of sexual assault/harassment, stalking, and domestic/dating violence. If you disclose any of these situations in class, in papers, or to me personally, I am required to report it to the Title IX Coordinator (or any of the Deputy Title IX Coordinators).

Academic Honesty

Students are required to uphold academic integrity throughout the course. In particular, the use of unauthorized materials or collaboration on quizzes or exams and other incidences of academic dishonesty will be handled according to the policies set forth in the Student Handbook.

Section	Exercises
§ 1.1: Background	1-12 (if non-linear, why?) 13, 15
§ 1.2: Solutions & Initial Value Prob	2, 3, 6, 7, 8, 9, 11, 17, 18, 22, 23, 25, 27
§ 1.3: Direction Fields	1, 3, 5, 10(a-c), 11, 15, 17, 19 (for 11-18, see our "Extras page" and use dfield)
§ 1.4: Euler's Method	1, 5, 7, 11, 15
§ 2.2: Separable Equations (1)	3, 5, 6, 7, 9, 11, 12, 15, 18, 19, 21, 23
§ 2.2: Separable Equations (2) § 2.3: Linear Equations (1)	13, 22, 25 1, 3, 4, 5, 7, 11, 17
§ 2.3: Linear Equations (2)	14, 15, 18, 20, 22, 28, READ: 36
§ 2.4: Exact Equations (1)	1, 2, 7, 9, 11, 12, 13, 19, 23, 25
§ 2.4: Exact Equations (2)	6, 8, 16, 22, 26
§ 2.6: Substitutions and Transformations (1)	1, 2, 5, 6, 7, 8, 9, 10, 12, 13 $(t > 0)$, 18, 22, 23, 25, 27
§ 2.6: Substitutions and Transformations (2)	Finish problem set.
Chapter 2 Review	Chapter 1 & 2 Review Worksheet
Exam 1	
§ 3.1: Mathematical Modeling	Handout Problems
§ 3.2: Compartmental Analysis (1)	1, 5, 7, 8
§ 3.2: Compartmental Analysis (2)	4, and §2.3: 35
§ 4.1: Introduction to Linear 2nd Order § 4.2: Second Order Linear Equations	2, 5, 8 1, 5, 13, 15
§ 4.2: Second Order Linear Equations (1)	7, 17, 19, 22, 39, (27, 29 use any method to determine L.D.)
§ 4.2: Second Order Linear Eqns (2) § 4.3: Auxiliary Eqns; Complex Roots (1)	(28, 31 use any method to determine L.D.), 37 1, 3, 9, 11, 17, 21, 22, 24
§ 4.3: Auxiliary Eqns; Complex Roots (2)	26, 29, 31(a-c), 32a, 33a
Exam 2	
§ 4.4: Nonhomogeneous Equations (1)	1-8, 13, 14, 15, 16, 18, 27
§ 4.4: Nonhomogeneous Equations (2) § 4.5: The Superposition Principle (1)	17, 21, 24, 29 3, 8, 10, 11, 12, 15
§ 4.5: The Superposition Principle (2)	17, 21, 24, 25, 27, 33, 35

…continued on the next page…

Section	Exercises
§ 4.6: Variation of Parameters (1)	1, 2, 3, 7, 14
§ 4.6: Variation of Parameters (2) § 4.7: Variable-Coefficient Equations (1)	11, 15, 17 5-8, 11, 13, 19
§ 4.7: Variable-Coefficient Equations (2)	1, 2, 24(a,b), 45, 47, 37, 39
§ 4.7: Variable-Coefficient Equations(3)	40, 41, 43, 48
§ 4.9: A Closer Look at Free Vibrations	1, 3, 5, 9, 12, 18
Chapter 4 Review Problems:	1, 3, 7, 9, 11, 21, 25, 30, 31, 35, 38
Exam 3	
§ 9.1: Systems Intro § 9.2: Linear Algebra Review § 9.3: Matrix Methods and Vectors	1, 3, 5, 7, 11 1, 3, 7, 12 READ SECTION 9.3; work: 1, 4, 5, 21, 23, 25 Note, we will not be finding inverses
§ 9.3: Matrix Methods and Vectors § 9.5: Eigenvalues/Eigenvectors	27, 33, 34, 35, 37, 39 3, 5, 7, 10
§ 9.4: Linear Systems in Normal Form (1)	1, 3, 5, 7, 9, 11, 21, 24, 26
§ 9.4: Linear Systems in Normal Form (2)	Get caught up
§ 9.5: Homogeneous Linear Systems (1)	11, 13, 15, 31, 32
§ 9.5: Homogeneous Linear Systems (2)	14 (Get caught up)
§ 9.6: Linear Sys Complex Eigenvals (1)	1, 3, 13, 14
§ 9.6: Linear Sys Complex Eigenvals (2)	Handout (Get caught up)
§ 5.4: Intro to the Phase Plane (1)	
Qualitative Methods	Handout Problems
Exam 4	

Math 240 · Differential Equations Course Schedule · Spring 2021

Monday	Wednesday	Friday
Jan 25 § 1.1: Background	Jan 27 § 1.2: Solutions & IVPs	Jan 29 § 1.3: Direction Fields
Feb 1 § 1.4: Euler's Method	Feb 3 § 2.2: Separable Equations (1)	Feb 5 § 2.2: Separable Equations (2) § 2.3: Linear Equations (1)
Feb 8 § 2.3: Linear Equations (2)	Feb 10 § 2.4: Exact Equations (1)	Feb 12 § 2.4: Exact Equations (2)
Feb 15 § 2.6: Substitutions and Transformations (1)	Feb 17 No Class: Break	Feb 19 § 2.6: Substitutions and Transformations (2)
Feb 22 Chapter 2 Review	Feb 24 Exam 1	Feb 26 §§ 3.1 - 3.2: Mathematical Modeling (1)
Mar 1 §§ 3.1 - 3.2: Mathematical Modeling (2) § 3.2: Compartmental Analysis (1)	Mar 3 § 3.2: Compartmental Analysis (2)	Mar 5 §§ 4.1 - 4.2: Second Order Equations The Mass-Spring Oscillator
Mar 8 § 4.2: Second Order Equations Homogeneous Linear Equations (1)	Mar 10 § 4.2: Second Order Equations (2) § 4.3: Complex Roots (1)	Mar 12 § 4.3: Auxiliary Equations with Complex Roots (2)
Mar 15 § 4.4: Nonhomogeneous Equations (1)	Mar 17 Exam 2	Mar 19 § 4.4: Nonhomogeneous Equations (2) § 4.5: Superposition Principle (1)
Mar 22 § 4.5: Superposition Principle and Undetermined Coefficients (2)	Mar 24 § 4.6: Variation of Parameters (1)	Mar 26 § 4.6: Variation of Parameters (2) § 4.7: Variable-Coefficient Equations (1)
Mar 29 § 4.7: Variable-Coefficient Equations (2)	Mar 31 § 4.7: Variable-Coefficient Equations (3)	Apr 2 § 4.9: A Closer Look at Free Mechanical Vibrations
Apr 5 § 4.9: Mechanical Vibrations Chapter 4 Review	Apr 7 No Class: Break	Apr 9 Exam 3
Apr 12 §§ 9.1 - 9.3: Review Matrix Methods and Vectors	Apr 14 § 9.3: Further Linear Algebra: eigenvalues & eigenvectors	Apr 16 § 9.3: Further Linear Algebra (II)
Apr 19 § 9.4: Linear Systems	Apr 21 § 9.5: Homogeneous Linear Systems Constant Coefficients (1)	Apr 23 § 9.5: Homogeneous Linear Systems Constant Coefficients (2)
Apr 26 § 9.6: Homogeneous Linear Systems Complex Eigenvalues (1)	Apr 28 § 9.6: Homogeneous Linear Systems Complex Eigenvalues (2)	Apr 30 § 5.4: Introduction to the Phase Plane
May 3 Notes: Qualitative Methods Visualizing Differential Equations BRING YOUR LAPTOP	May 5 Exam 4	May 7 No Class: Reading Day