MATH 2455 – Section 102
Differential Equations for Biomedical and Civil Engineers

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Lectures: MWF 9-9:50am, Varsity Theatre
Course Website: D2L https://d2l.mu.edu/d2l/home/413104

Prof. Ongie's Office Hours: Mon 2-3pm, Tues 1-2pm, Wed 11am-noon, and by appointment.
TA's Office Hours: To be announced.

Office hours will be held virtually via Teams. Links to the Teams meetings will be provided on D2L.

Course Description

Methods and techniques for solving differential equations and systems of differential equations, with applications to biomedical and civil engineering. Prerequisites: MATH 2450 or MATH 1455, restricted to students in BIEN or CEEN.

Course Objectives

Upon successful completion of the course, the student should be able to identify and solve standard problems arising in differential equations using appropriate computational techniques. In particular a student will be able to:

1. Give definitions of key mathematical terms (e.g., differential equation, solution to an ordinary differential equation),
2. Apply differential equations to model various empirical behaviors,
3. Classify differential equations by type, order and linearity; e.g., common first- and second-order ordinary differential equations,
4. Select and apply appropriate methods to solve common first- and second-order ordinary differential equations,
5. Understand the purpose of the Laplace Transform and use it to solve differential equations,
6. Have a basic understanding of numerical techniques for solving ordinary differential equations.

Textbook

- *Differential Equations: An Introduction to Modern Methods and Applications* by Brannan and Boyce, Third Edition (ISBN: 978-1-118-53177-8).

For some assignments we will use WileyPlus, an online service that includes a digital copy of the textbook as well as online exercises. A WileyPlus access code can be purchased from directly from wiley.com. Access to the textbook through WileyPlus is not permanent and will terminate after the course ends. To register for our course section on the WileyPlus site, create an account and login to the "New WileyPlus Platform" at wileyplus.com/user-login and enter the Course Section ID: **A49985**.

Grading Policy

The final grade is earned out of 1000 total points distributed as follows:

- Online Skills Checks (WileyPlus): 100 pts.
- Written Homework: 200 pts.
- MATLAB Projects: 50 pts.
- Exams: Two exams at 200 pts each, 400 pts total.
- Final Exam: 250 pts.

Grading scale:

A	$930 \leq$ Total Points ≤ 1000	**C**	$680 \leq$ Total Points < 740
A-	$900 \leq$ Total Points < 930	**C-**	$630 \leq$ Total Points < 680
B+	$870 \leq$ Total Points < 900	**D+**	$600 \leq$ Total Points < 630
B	$810 \leq$ Total Points < 870	**D**	$550 \leq$ Total Points < 600
B-	$780 \leq$ Total Points < 810	**F**	Below 550 Points
C+	$740 \leq$ Total Points < 780		

Online Skills Checks (WileyPlus)

Online skills checks will be regularly assigned on WileyPlus. Unless otherwise noted these will be due on *Thursdays by 5:00 pm*. Due dates are final. Regarding the distribution of the 100 points for the skills checks, if a student earns at least 80% of all possible assigned problem points (80 points), then the student will receive a grade of 100% (i.e., all 100 points). Scores of less than 80% will be computed as a percentage of the 100 points (i.e., as $\frac{\text{Your \%}}{80\%} \times 100$).

Written Homework

- There will be 11 graded hand-in homework assignments. Unless otherwise noted, these will be due on *Sunday 11:59pm* by upload to the D2L dropbox. Complete solutions will be posted on D2L.
- Each assignment is worth 20 points. Three problems per assignment will be graded, each out of a possible 6 earned points. The remaining 2 points are earned by completion of the assignment as a whole. With a few possible exceptions, the 6 points will be divided as follows: 4 points for the mathematical content of the solution, 2 points for communication.
  - For mathematical content, the scale is:
    - *4 Points*: The solution is 100% correct.
    - *3 Points*: The solution demonstrates a good understanding of the problem, but some small details are incorrect or missing.
    - *2 Points*: The solution is largely incorrect, but there are some good ideas in it.
    - *1 Point*: The problem was attempted, but no real progress was made towards a solution.
    - *0 Points*: No attempt was made at a solution.
  - The communication scale is:
    - *2 Points*: The solution is clear (in terms of both step-by-step logic and overall organization) and justified in sufficient detail. Written explanations are grammatical and given in complete sentences.
    - *1 Point*: The solution is mostly clear, but some details are missing and/or written explanations are ungrammatical or given in sentence fragments.

    - *0 Points*: The solution is mostly unclear and/or many details are missing and/or the solution is unprofessionally written.
  - The communication points will only be assigned if at least 2 points are earned on the mathematical content.

- Format for Written Work: Each problem writeup must begin on a new sheet of paper and must begin with the full statement of the problem. Failure to do so with be reflected in the 2 pts for completion of the assignment. While you are encouraged to work through confusion with your classmates, your work must be written in your own words unless otherwise stated.

- **Your homework must be uploaded as a single pdf file to the D2L dropbox.** There are several free apps to help with this including CamScanner and Genius Scan among others. Please make sure your scanned homework is legible before uploading. Scanned homework that cannot be read or that is uploaded as multiple files and/or in the wrong format (i.e., not a single pdf) will not be graded and given an automatic 0. Occasionally you may need to merge pdfs before uploading to D2L. There are several free online apps to do this as well, such as combinepdf.com.

- **No late homework is accepted.** However, your single lowest homework score will be dropped at the end of the semester.

MATLAB Projects

- There will also be a few assigned projects that make use of the MATLAB computing toolbox.

- Marquette University students may download MATLAB onto their personal computers: `http://www.marquette.edu/its/help/matlab/`. MATLAB is also available in the computer labs of Cudahy Hall and in Engineering and the library. Note, most of you will not need all of the extra toolboxes which significantly add to the size of the program on your computer as well as the download time. You are encouraged to check access to MATLAB by Friday August 28, 2020 to ensure proper access moving forward. Please contact ITS with questions about downloading and installing MATLAB on your device.

- Similar to written homework, MATLAB projects will be due via upload to a dropbox on D2L.

Exams

- There will be two midterm exams and one comprehensive final. The midterm exams are scheduled for Friday October 2nd and Friday November 13th. I reserve the right to adjust the midterm exam schedule as needed.

- An absence from an exam is recorded as a score of 0. Make-up exams will not be given unless the student informs, and has a come to a written agreement with, the instructor regarding the absence no later than the day before the exam day. The student is responsible for scheduling their make-up exam.

- The Final Exam will be held Thursday December 3rd, 1-3 pm.

Course Policies

Class Conduct

- **COVID-19 Specific Rules**: All students (and the instructor) will be required to wear a face mask that covers the mouth and nose, and engage in social distancing by six feet or more. Students who do not comply will be asked to leave the classroom – no exceptions.

- Norms for classroom conduct are based on respect for the instructor and your fellow students. While in class, please silence your cell phones. If for some good reason you need to be reachable by phone during the class please let me know in advance. Behaviors such as texting, reading newspapers, sleeping, watching videos, or otherwise distracting your fellow students are inappropriate.

Attendance Policy

Students are expected to attend the in-person lectures. However, due to the COVID-19 pandemic, I realize that this may not be possible for all students at all times. To accommodate students that miss an in-person lecture, I will be recording videos of the lectures which will be posted on D2L shortly after the lecture ends. In the event that a student requires a prolonged absence (two or more consecutive in-person lectures), please contact me as soon as possible so I can make reasonable accommodations, especially if the absence includes an exam date.

E-mail Policy

Please follow the "Three-Before-Me" rule: If you have questions regarding the material, assignments, technical issues, etc., please seek out at least three other sources of information to obtain an answer before e-mailing me or the TA about it. These sources of information could include your classmates, an internet search, information posted on D2L, or this very document. Please do not e-mail or message me on the D2L or WileyPlus platforms; I will not be checking these platforms for messages.

Grading Disputes

If you have any issue with the grading of your homework, WileyPlus, or in-class exams you must inform me in writing via e-mail within seven days of the day the assignments were returned to the class; otherwise I cannot promise that I will consider the issue.

Accommodations for Disabilities

If you have a disability and will require accommodations under the Americans with Disabilities Act, you need to provide appropriate documentation to the Office of Disability Services. They will supply you with a letter to give to me detailing the accommodations. If you are unsure of whether or not you qualify for services, visit the Office of Disability Services' website, http://www.marquette.edu/disability-services, or contact them at (414) 288-1645. If you qualify for special accommodations you must work with the course instructor and come to an agreement no less than 7 days prior to the needed accommodation.

Academic Support

It is your responsibility to keep abreast of the course, to master the material covered, and to take the initiative for getting any help you may need. *You are encouraged to obtain help from the course instructor and TA by attending office hours.* If additional support is needed, the MUSC Tutorial Program offers tutoring services for MATH 2455. For more information see the website at http://www.mu.edu/oses.

Academic Integrity and Honesty

Academic dishonesty will not be tolerated. In particular, representing another person's work as your own is academic dishonesty. This applies to all activities, homework, project work, assignments, etc. Any time you use and present ideas that are not your own you must cite your sources. Failure to abide by the university "Academic Integrity Policy"(http://bulletin.marquette.edu/undergrad/academicregulations/) may result in disciplinary action.

Tentative Course Schedule

The schedule below is tentative and subject to change. Exam dates are listed in red.

		Dates	Content	Text Sections	Notes
Unit 1:	**Week 1**	8/26, 8/28	Intro to DEs	1.1, 1.2, 1.3	HW 0 Due
1st order DEs	**Week 2**	8/31, 9/2, 9/4	Separable DEs, method of integrating factors, modeling	2.1, 2.2, 2.3	HW 1 Due
	Week 3	9/9, 9/11	Modeling with ODEs, and existence/uniqueness	2.3, 2.5, 2.4	HW 2 Due
Unit 2:	**Week 4**	9/14, 9/16, 9/18	Numerical methods and linear algebra	8.1, 8.3, 8.4, 3.1, Appendix A	HW 3 & MATLAB Project
1st Order Linear Systems of ODEs	**Week 5**	9/21, 9/23, 9/25	Linear algebra and 1st order systems	3.1, 3.2, begin 3.3-3.5	HW 4 Due
	Week 6	9/28, 9/30, **10/2**	Solving 1st order systems of ODEs	3.3, 3.4, 3.5	**EXAM 1, Fri 10/2**
Unit 3:	**Week 7**	10/5, 10/7, 10/9	Second order linear ODEs	4.1, 4.2	HW 5 Due
2nd Order Linear DEs	**Week 8**	10/12, 10/14	Homogeneous 2nd Order ODEs with constant coefficients, method of undetermined coefficients	4.3, 4.5	HW 6 Due
	Week 9	10/19, 10/21, 10/23	Variation of parameters	4.6, 4.7	HW 7 Due
Unit 4:	**Week 10**	10/26, 10/28, 10/30	Intro to Laplace transforms	5.1, 5.2	HW 8 Due
Laplace Transforms	**Week 11**	11/2, 11/4, 11/6	Solving DEs with LTs, Heaviside functions	5.3, 5.4, 5.5, 5.6	HW 9 Due
	Week 12	11/9, 11/11, **11/13**	Delta Functions and Convolution	5.7, 5.8	**EXAM 2, Fri 11/13**
Unit 5:	**Week 13**	11/16, 11/18, 11/20	Numerical SIR Models, Predator-Prey Systems	Supplemental Material	MATLAB Project
Extensions	**Week 14**	11/23	Series solutions to ODEs	9.1, 9.2	HW 10 Due
	Week 15	**12/3, 1-3 pm**			**FINAL EXAM**