ME EN 2450
Numerical Methods for Engineering Systems
Spring 2019

Lecturer:	Jacob Hochhalter
Lecture:	Tuesday and Thursday, 2:00 - 3:20 PM in WEB L103
Office Hours:	Tuesday and Thursday, 3:30 - 4:30 PM in MEK 2558
Lab Room:	WEB L208 (all sections)
E-mail:	please use Canvas for all correspondence
Web Page:	CANVAS and GRADESCOPE
Text:	*Numerical Methods for Engineers 7th Edition* by S.C. Chapra and R.P. Canale McGraw-Hill 2015 (older/newer editions should work as well)
Class/Lab TAs:	Loren Atwood (communicate through Canvas) Zev Underwood (communicate through Canvas) Lucas Ulmer (communicate through Canvas)
Grader:	Trent Meisenheimer (communicate through Canvas)
TA Hours:	TBD

Description of the Course: Use of basic numerical methods to solve problems related to the dynamics, modeling, design and testing of mechanical systems. Topics covered include: root finding, interpolation, approximation of functions, integration, differential equations, direct and iterative methods in linear algebra, and curve fitting. Labs will focus on analysis for a design project. During the course, students will develop a toolbox of numerical methods that are designed to be used in future classes and throughout their careers.

Prerequisite:	ME EN 1010 Introduction to Robot Systems Design II
Corequisite:	MATH 2250 Ordinary Differential Equations and Linear Algebra

Grading Scale:

93 – 100%:	A
90 – 92%:	A-
87 – 89%:	B+
83 – 86%:	B
80 – 82%:	B-
77 – 79%:	C+
73 – 76%:	C
70 – 72%:	C-
67 – 69%:	D+
63 – 66%:	D
60 – 62%:	D-
below 60%:	E

Final grading scale may be lowered by the instructor based on the overall class performance, but will not be raised.

Course Objectives:

- Develop a toolbox of numerical methods useful for solving engineering problems.
- Demonstrate and practice the use of numerical methods in solving engineering problems.
- Be proficient in using MATLAB or Python to solve engineering problems.
- Introduce commercial numerical engineering tools (such as Solidworks) to solve engineering problems.
- Reinforce and enrich previously learned concepts related to the design process.

Outcomes:

At the completion of ME 2450, students will be able to:

- Identify the appropriate numerical methods to solve a variety of engineering equations.
- Solve a variety of typical engineering equations and problems using numerical methods
- Write their own MATLAB and/or Python code to implement numerical solutions to engineering problems
- Use SolidWorks to perform basic analytical and characterization procedures on engineering structures.

Scope of the Course: The lecture material will cover part or most of the material in chapters 1 through 12, chapter 17, and chapters 21 through 30. Several supplemental handouts will also be provided and lectures will be provided related to appropriate physics and numerical methods applications. The reading assignments (see schedule) are arranged such that they are to be completed prior to when the material will be covered in the lecture. In other words, it is a good idea to read the assigned sections before coming to lecture.

Lecture Materials: Outside of class, I will communicate with you via Canvas. The course syllabus, lecture slides, assignments, any supplementary materials, and class announcements will be posted in Canvas. While the lecture slides contain important concepts that we will cover in class, I will go into more depth during lecture, which includes working through example problems on the board. The worked-out example problems from lecture and discussions will not be posted on Canvas. Therefore, it is imperative that you attend both lecture and discussion. You can request help or schedule office hours with me or any of the TAs using the messaging system in Canvas.

Homework: Some homework assignments will involve hand-written work, while others will require programming. All homework will be due by 5 PM on the specified due date and must be submitted via Gradescope (https://www.gradescope.com/). A step-by-step tutorial is provided here: https://youtu.be/KMPoby5g_nE. Programming assignments must be submitted on Gradescope, where we have software that checks for copying and cheating. Programming assignments handed in by e-mail or in hard copy will not receive credit. The TAs will grade the assignment directly in the program, and feedback will be provided immediately upon completion.

All students enrolled in the course as of January 2nd, 2019, have automatically been added to Gradescope. If you registered after that date, please let me know. Try to work through the homework problems until you understand them well enough that you can teach someone else.

Coding: You are expected to be (or quickly become) proficient in a programming language (e.g. C, C++, Matlab, Python, FORTRAN, etc.). Matlab and/or Python will be used during the semester. Each assignment will specify the appropriate language or package to be used. If no language is specified, Matlab or Python is the expected default.

Labs: Weekly labs will be held in WEB L208. In general, these will either consist of programming assignment or an Arduino programming assignment. Although most of the work for these assignments can be completed during your three-hour lab time, you should expect to spend some time each week outside of lab working on your assignments. The GRADESCOPE site will be updated as the semester progresses with information to prepare you for the lab assignments each week. There will be a pre-lab quiz for lab most weeks (excluding the first week). These should be completed before you come to your lab session during the week, as this will allow you to reap the greatest benefit from the instructions your lab TA will provide. They must be done by Friday at 5pm though.

All files for lab assignments are due no later than 10 minutes before the beginning of your next lab time (i.e., if your lab time is 2-5 PM on Tuesday, you must turn in your lab assignment by 1:50 PM the next Tuesday).

There will be a final lab exam that will be taken individually during a regularly scheduled lab class. The exam will be worth 2 labs.

Late lab work will not be accepted for any reason. Your lab TA is responsible for grading your lab assignments. Any questions regarding grading of your lab assignments should be directed to your lab TA.

Note: Labs sessions will not be held the first week. If you cannot make your lab time for any reason, please notify your TA at least 6 hours in advance. We will work to fit you into another lab. Emergency lab time changes (i.e. sickness, accident) or make-up labs must be approved by your lab TA. Failure to attend your lab as assigned or as authorized by a lab TA will result in a zero for that lab HW grade.

Quizzes: In-class quizzes will be given periodically over the course of the class. Some of these will be graded (i.e., you will be penalized for incorrect answers) and some will count only as participation quizzes (i.e., you will get points for any answer, right or wrong).

Project: Students will work individually to complete a numerical methods-based design project. As part of this project, various homework assignments, known as Algorithm Integration for Design (AID) Assignments, will be given over the course of the semester. These will be graded on your technical completeness and your communications techniques, as appropriate. The final deliverable for this class will be a report describing your design in detail. An important component of this final report will be your supporting calculations, which should demonstrate the viability of your design and illustrate the reasons for the decisions you have made. These evaluations will likewise contribute to your Project grade.

Exams: There will be a Midterm Exam held during the class lecture time. The Final Exam will be held in WEB L103 on Tuesday, April 25, 2019 from 1:00 – 3:00 pm, as listed in the official University schedule. The Midterm will cover everything we have discussed in lecture up to that point. The Final Exam will cover topics discussed after the Midterm, although some material from the first half of the class may appear. No alternate scheduling arrangements will be made.

Grading: The total course grade is comprised of homework, lab assignments, quizzes, the project, a midterm exam and a final exam. The grading scheme is as follows:

Homework:	20%
Labs:	20%
Design Project:	20%
Quizzes/Participation:	5%
Midterm Exam:	15%
Final Exam:	20%

No late homework, lab or project-related assignments will be accepted. In-class participation quizzes will only be given during class and cannot be made up outside of class. There will be no way to make up quizzes. The exam dates are listed on the syllabus and cannot be rescheduled. Please plan accordingly. To receive a passing grade in this class, you are required to:

1. Pass the Lab part of the course.
2. Pass the Midterm and the Final Exam parts of the course together.

Academic Integrity: From the University's Code of Student Rights and Responsibilities:

> *"Academic misconduct" includes, but is not limited to, cheating, misrepresenting one's work, inappropriately collaborating, plagiarism, and fabrication or falsification of information* (see https://regulations.utah.edu/academics/6-400.php for more details). *It also includes facilitating academic misconduct by intentionally helping or attempting to help another to commit an act of academic misconduct.*

You are allowed, expected, and encouraged to collaborate on homework by sharing ideas, verbally. Copying written work or code will not be tolerated. Shared work will receive a shared grade, meaning that the assignment score will be divided by the number of students submitting identical work. Cheating on an exam will result in failure of the class. Also, submitted work copied from others will be considered academic misconduct and will be reported to the appropriate University entities.

Clarifying examples (not comprehensive, but intended to make the line clear):

In ME EN 2450, academic misconduct is not:

- Discussing course materials with classmates
- Verbally communicating about assignments
- Helping classmates learn software used in class or labs
- Using the internet for instruction beyond details provided in class
- Working with a tutor or your TA

In ME EN 2450, academic misconduct is:

- Transcribing or copying/pasting other classmates' work
- Allowing others to copy your work
- Uploading assignments without consent of the professor (e.g. to Course Hero or Chegg)
- Soliciting for solutions online
- Splitting assignment workload and submitting a combined result

Students must provide acknowledgment of the ME EN Academic Misconduct policy and course specific definitions of academic misconduct via the Canvas Academic Integrity Module for this course before the end of the second week of class or they will be asked to drop the class and will otherwise receive an EU grade.

Students with Disabilities: The University of Utah seeks to provide equal access to its programs, services and activities for people with disabilities. If you will need accommodations in the class, reasonable prior notice needs to be given to the Center for Disability Services, 162 Olpin Union Building, 581-5020 (V/TDD). CDS will work with you and the instructor to make arrangements for accommodations. All written information in this course can be made available in alternative format with prior notification to the Center for Disability Services.

College of Engineering (COE) Guidelines:

Please visit the link below to familiarize yourself with the COE guidelines pertaining to the spring 2019 semester.

https://www.coe.utah.edu/semester-guidelines

Spring 2019 Class Schedule

Week	Date	Homework[1]	Reading	Lecture Topic	#	Lab[2]
1	1/8/2019		Ch1	Introduction, System Modeling		No Labs
	1/10/2019	AIM[3]	Ch1	Numerical Modeling Concepts		
2	1/15/2019		Ch2,3	Coding Concepts	1	Coding - System Modeling
	1/17/2019	HW1a	Ch4	Roundoff and Manipulation Errors		
3	1/22/2019		Ch5	Truncation Error and Taylor Series		**No Labs - MLK Day week**
	1/24/2019	HW1b	Ch6	Roots of Equations - Introduction		
4	1/29/2019		Ch7	Roots of Equations - Open Methods	2	Arduino 1 - Intro
	1/31/2019	AID 1	Ch8	Roots of Equations - Polynomials		
5	2/5/2019		Ch9	Linear Equations - Introduction	3	Coding - Roots 1
	2/7/2019	HW 2	Ch9	Linear Equations - Gauss Elimination		
6	2/12/2019		Ch10	Linear Equations - LU Decomposition	5	Coding - Roots 2
	2/14/2019	HW 3	Ch11	Linear Equations - Gauss-Seidel		
7	2/19/2019		Ch12	Linear Equations - Jacobi	6	Arduino 2 - Lin Eq 1
	2/21/2019	HW 4	Ch25	ODE - Introduction		
8	2/26/2019		Ch25	ODE - Runge-Kutta	7	Coding - Lin. Eqn. 2
	2/28/2019	AID 2	Ch26	ODE - Runge-Kutta		
9	3/5/2019			Midterm Review	4	SolidWorks 1 - External
	3/7/2019			Midterm Exam		
	3/12/2019	**Spring Break**				
	3/14/2019					
10	3/19/2019		Ch27	Boundary Value Problems	8	SolidWorks 2 - Internal
	3/21/2019	HW 5	Ch27	Eigenvalue Problems		
11	3/26/2019		Ch17	Least Squares Regression	9	Coding - ODE Part 1
	3/28/2019		Ch17	Least Squares Regression		
12	4/2/2019		Ch18	Interpolation	10	Coding - ODE Part2
	4/4/2019	HW 6	Ch21	Numerical Integration - Basic Methods		
13	4/9/2019		Ch22	Gauss Quadrature	11	**Lab Exam**
	4/11/2019		Ch23	Numerical Differentiation		
14	4/16/2019		Ch13,14	Optimization	12	DP Meet with TAs
	4/18/2019	HW 7	Ch15	Optimization		
15	4/23/2019			Final Exam Review		
	4/25/2019	Design Project		Final Exam (1:00 PM - 3:00 PM)		

1 Homework Assignments and AID Assignments are due by 5 PM on the specified due date.

2 Lab Assignments are due 10 minutes before your next lab period.

3 Complete the Academic Integrity Module in CANVAS

Updated 04 January 2019