Introduction to Numerical Methods of Engineering Analysis

EGM 3344 Section 3415 (13213)
Class Periods: MWF, 7nd period (1:55 PM - 2:45 PM)
Location MCCC 0101
&
EGM 3344 Section 4706 (13215)
Class Periods: MWF, 9th period (4:05 PM - 4:55 PM)
WEIL 270

Academic Term: Spring 2023

It may become necessary to modify this syllabus during the semester.
In this event, students will be notified and the revised syllabus will be posted on the course web site.

Instructor:

Name: Renwei Mei
Email Address: rwmei@ufl.edu
Office Phone #: 352-392-0888
Office location: NEB Room 127
Office Hours: MWF, 11:00-12:00 pm @ NEB 127

Graders:

Colton Shepard
Sri Harsh Matt

Course Description

Methods for numerical solution of mathematical problems, with emphasis on engineering applications and computer implementation in MATLAB. Modeling, computers, and error analysis. Roots and optimization. Linear algebraic equations and matrices. Curve fitting; Numerical differentiation and integration. Ordinary differential equations. Credits: 3.

Course Pre-Requisites / Co-Requisites

Requisites: MAC 2313 Analytic Geometry and Calculus 3;

COP 2271, or equivalent Computer Programming for Engineers Matlab

Co-requisites: MAP 2302 Elementary Differential Equations

Course Objectives

The objective of the course is to teach students how to apply computational methodologies to solve engineering problems when no closed-form, analytical solution exists. Students will learn the basics of using structured programming to combine engineering knowledge, judgment, and intuition to develop reasonable approximations and numerical solutions. Emphasis will be placed on understanding the basic concepts behind the various numerical methods studied, implementing basic numerical methods using the MATLAB structured programming environment, and utilizing more sophisticated numerical methods provided as built-in MATLAB functions. The objective will be achieved through:

- In class lectures and examples

- Student completion of homework and a project
- Student preparation for and completion of exams

Materials and Supply Fees
NONE

Relation to Program Outcomes (ABET):

Outcome	Coverage*
1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	High
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	
3. An ability to communicate effectively with a range of audiences	Low
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	Low
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies	Low

*Coverage is given as high, medium, or low. An empty box indicates that this outcome is not covered or assessed in the course.

Required Textbooks and Software

- *Applied Numerical Methods with MATLAB for Engineers and Scientists*
- Author: Steven C. Chapra
- 2017, Forth Edition, McGraw Hill
- ISBN number: 978-0073397962

Required Computer:
It is important that you have your own computer. Details are provided on both the department and college websites:

- https://www.eng.ufl.edu/students/resources/computer-requirements/

- https://mae.ufl.edu/academics/prospective/undergraduate/computer-requirements/

Recommended Materials

- None

Course Schedule

Spring 23	Lecture	HWs, Project, & Exams	Topic	Chapter
1/9/2023	1		Syllabus/Intro	ch 1
1/11/2023	2	HW1 assigned	Numerically solving ODE	ch 1
1/13/2023	3		Round-Off and Truncation Errors	chs 4, 21
1/16/2023	Holiday			
1/18/2023	4		Floating point number & machine epsilon	ch 4
1/20/2023	5	HW1 due; HW2 assigned	Erros combined & root finding	chs 4, 5
1/23/2023	6		Root finding --Bisection	ch 5
1/25/2023	7		False-Position & Fixed-point iteration	chs 5, 6
1/27/2023	8	HW2 due; HW3 assigned	Newton method	ch 6
1/30/2023	9		Modified Secant fzero & polynomial	ch 6
2/1/2023	10		Linear Algebra & Matrices operation	ch 8
2/3/2023	11	HW3 due; HW4 assigned	Solving system of eqns & Determinant	8.2, 9.1
2/6/2023	12		Cramer's rule & Gauss Elimination	9.1,9.2
2/8/2023		Exam 1	Exam 1	
2/10/2023	13		Naïve Gauss elimination	9.2
2/13/2023	14	HW4 due; HW5 assigned	Operation count & partial pivot	9.2, 9.3
2/15/2023	15		Tridiagonal Matrix & LU decomp	9.4, 10.1
2/17/2023	16		Cholesky deoomp, inv. matrix, matrix norm	10.2-3,11.1-2
2/20/2023	17	HW5 due; HW6 assigned	matrix condition; iterative methods	11.2;12.1
2/22/2023	18		Gauss-Seidel & relaxation	12.1
2/24/2023	19		Nonliear system of eqns.	12.2
2/27/2023	20	HW6 due; HW7 assigned;	Eigenvalue problems	13.1-2
3/1/2023	21		power method	13.3
3/3/2023	22	Project assigned	linear dependence& linear regression	13.3,14.1
3/6/2023	23	HW7 due; HW8 assigned	Least square error in regression	14.3
3/8/2023		Exam 2	Non-cumulative	
3/10/2023	24		Non-linear regression	14.4, 15.1
3/13/2023	Spr brk			
3/15/2023	Spr brk			
3/17/2023	Spr brk			
3/20/2023	25		Multi linear regression & Interpolation	15.2; 17.1
3/22/2023	26	HW8 due; HW9 assigned	Polynomial interpl. & Divided difference	17.1-17.2
3/24/2023	27		Lagrange interpolation	17.3
3/27/2023	28		Interpl. error, spline, & Trapezoidal rule	ch 18, 19.1-3
3/29/2023	29	HW9 due; HW10 assigned	Simpson's rules	19.4
3/31/2023	30		Composite Simpson & unequal segment	19.4,19.6
4/3/2023	31		Richardson extrap. & Romberg integration	20.1-2
4/5/2023		Exam 3	Non-cumulative	

4/7/2023	32	HW10 due; HW 11 assigned	Gauss Quadrature	20.3
4/10/2023	33	Project due	Fourier series of period 2p	"chapt 16"
4/12/2023	34		Fourier series example	"chapt 16"
4/14/2023	35	HW11 due; HW12 assigned	Even odd extension	"chapt 16"
4/17/2023	36		Fourier Integral & transform	"chapt 16"
4/19/2023	37		Heuns, mid-point, & RK methods for IVPs	22.3
4/21/2023	38		RK4 & system of ODEs	22.4
4/24/2023	39	HW12 due	Adaptive methods & stiff systems	23
4/26/2023		Exam 4	Non-cumulative	DONE

Coverage of topics is subject to change & adjustment depending on the progress.

Attendance Policy, Class Expectations, and Make-Up Policy

Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies. Click here to read the university attendance policies:
https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/

Regular class attendance is expected. Students attendance will be collected randomly and course attendance will be a factor in determining course grade.

Late HW and makeup exams are only allowed for students with documented circumstances consistent with UF policy. Students must contact the instructor via email as soon as possible to provide documentation and request a make-up exam.

No early exam will be given to ANY student.

HW:

i) HW will be regularly assigned on Canvas e-learning course website.

ii) For each assigned problem, answer key will be given (unless too obvious to reveal the entire solution) to guide you to completion. Detailed solutions will be posted after you have turned in your HWs. Please review posted solutions carefully to enhance your understanding.

iii) To receive full credit, you will be required to complete all assigned problems AND to follow the homework formatting instructions provided in the course site.

iv) Not all HW problems will be graded. TA/grader will randomly pick certain problems to grade thoroughly. Each graded problem will receive a maximum of 10 points.

v) For problems that are completed but are not graded, 5 points will be given for completeness.

Exams:

i) There will be FOUR during-term exams. They will be given in the evenings so that students from 2 different sections can take them at the same time. If you have a scheduling conflict with a higher number course, please email me with a subject heading of "Exam conflict" as early as possible. I will work with you to resolve the conflict.

ii) The exams are closed-book and closed notes, but you are allowed to bring ONE piece of 8.5x11" formula sheet for each exam.

iii) NO CELL PHONE (or anything that can store formulae) is allowed during the writing of exam.
NO programmable calculator is allowed during exams.
Only scientific calculators (such as TI-36, Casio,…) are allowed during exams.

vi) Some of the exam problems will be multiple choice type. Those problems will emphasize on the concepts. Most will require written response involving derivation and calculations. The emphasis of the exams will be to test your understanding, not on formulaic repetition, so expect the exam problems to test your grasp of the methods taught in the class.

vii) Some problems may be taken directly from the homework problems or from lecture discussions with some modifications. Thus, in addition to the weight placed on homework in the final grade, it is to your advantage to understand as many of the homework problems in the textbook as possible.

viii) Sample exams will be provided to you prior to the actual exam.

If you do not agree with the grading of a particular HW/ Exam problem, you will have one week from the date the exam is graded to email ME a written explanation of why you think the grade should be higher. However, the final decision will remain the instructor's.

Please do not contact graders for grading dispute.

Study group:

A study group would be an excellent place to discuss the concepts, codes, and solution process to each problem. After the discussions, however, each one should write own solution.

If two identical copies of solutions/codes are uncovered, I reserve the right to give 0 credit to each student and report the incident to the appropriate university offices for further investigation.

Extra assignment/project for an individual to improve bad grade: None

If you receive low grades for the first few HW sets or your first exam, and you want to improve your future performance, please contact me. I will be more than happy to analyze your situation and discuss strategies to enhance your learning and improve grades for future assignments and exams. **DO NOT** wait till (or after) the end of semester to ask for extra-credit work as there will be none given.

- 12 Homework assignments are planned.
- One course project will be assigned.
- Four during-term exams will be given in the evenings;

  the highest 3 exam scores get a weight of 24% for each;

  the lowest score of the 4 exams gets a weight of 12%.

Assignment	date	% of Final Grade
Homework (12)	10 per problem	10%
Project (1)	Due on 4/6/2023	6 %
Exams		84%
Exam 1	Wed, 2/8/2023	(12-24%)
Exam 2	Wed, 3/8/2023	(12-24%)
Exam 3	Wed, 4/5/2023	(12-24%)
Exam 4	Wed, 4/26/2023	(12-24%)

The time for Exams will be 8:20-10:00 pm & locations will be announced later.

***DO NOT** rely on the average given by Canvas gradebook.*

Use the weights given above to assess your tentative course performance during the semester.

Grading Policy

Percent	Grade	Grade Points
93.4 - 100	A	4.00
90.0 - 93.3	A-	3.67
86.7 - 89.9	B+	3.33
83.4 - 86.6	B	3.00
80.0 - 83.3	B-	2.67
76.7 - 79.9	C+	2.33
73.4 - 76.6	C	2.00
70.0 - 73.3	C-	1.67
66.7 - 69.9	D+	1.33
63.4 - 66.6	D	1.00
60.0 - 63.3	D-	0.67
0 - 59.9	E	0.00

More information on UF grading policy may be found at:
https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx

Students Requiring Accommodations
Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting https://disability.ufl.edu/students/get-started/. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Course Evaluation
Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at https://gatorevals.aa.ufl.edu/students/. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via https://ufl.bluera.com/ufl/. Summaries of course evaluation results are available to students at https://gatorevals.aa.ufl.edu/public-results/.

In-Class Recording
Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A "class lecture" is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history,

academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To "publish" means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

University Honesty Policy

UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code (https://sccr.dso.ufl.edu/process/student-conduct-code/) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Commitment to a Safe and Inclusive Learning Environment

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Program Coordinator
- Jennifer Nappo, Director of Human Resources, 352-392-0904, jpennacc@ufl.edu
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

Software Use

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student Privacy

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: https://registrar.ufl.edu/ferpa.html

Campus Resources:

Health and Wellness

U Matter, We Care:

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact

umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

Counseling and Wellness Center: https://counseling.ufl.edu, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Discrimination, Harassment, Assault, or Violence
If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the **Office of Title IX Compliance**, located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, title-ix@ufl.edu

Sexual Assault Recovery Services (SARS)
Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or http://www.police.ufl.edu/.

Academic Resources

E-learning technical suppor*t*, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu. https://lss.at.ufl.edu/help.shtml.

Career Connections Center, Reitz Union, 392-1601. Career assistance and counseling; https://career.ufl.edu.

Library Support, http://cms.uflib.ufl.edu/ask. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring. https://teachingcenter.ufl.edu/.

Writing Studio, 302 Tigert Hall*,* 846-1138. Help brainstorming, formatting, and writing papers. https://writing.ufl.edu/writing-studio/.

Student Complaints Campus*:* https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/;https://care.dso.ufl.edu.

On-Line Students Complaints*: https://distance.ufl.edu/state-authorization-status/#student-complaint*.