Introduction to Numerical Methods of Engineering Analysis

EGM 3344 Section 09DG Class# 13477

Class Periods: MWF **3** (9:35 am to 10:25 am)

EGM 3344 Section 2C99 Class# 22245

Class Periods: MWF **8** (3:00 pm to 3:50 pm)

Lectures will be delivered via recorded Zoom videos
for BOTH sections

Academic Term: Fall 2020

When this syllabus is modified during the semester
you will be notified and the revised syllabus will be posted.

Instructor:

Dr. Renwei Mei

Room 127 New Engineering Building (NEB)

Email: rwmei@ufl.edu;

 (Emails regarding the course should be sent to me via e-learning)

Personal **cell** phone: **352-682-5653**

Office Hours: MWTh 1:00 -2:00 pm   via Zoom

(I will send an invitation each time I hold office hour. If you do not plan to attend the office hour, just dismiss it. Do NOT respond by sending a decline message to me).

Teaching Assistant: Ms. Tingting Zeng

Office hour: Tuesday 2-3 pm via Zoom

Grader:

Mr. Zheng Ren

Catalog 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 projects
- Student preparation for and completion of exams

Professional Component (ABET):

This course prepares graduates to apply knowledge of calculus based physics to engineering modeling, knowledge of advanced mathematics through multivariate calculus and differential equations to engineering problem solving, and knowledge of statistics and linear algebra to data analysis.

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 significantly addressed by this course.

Materials and Supply Fees

None

Required Textbooks and Software

- *Applied Numerical Methods with MATLAB for Engineers and Scientists*, Steven C. Chapra, 2017, Forth Edition, McGraw Hill, (ISBN number: 978-0073397962-- for hardcopy; see electronic access below)

Please note that this course will be participating in the UF All Access program. Login at the following website and Opt-In to gain access to your required course materials - https://www.bsd.ufl.edu/G1CO/IPay1f/start.aspx?TASK=INCLUDED – UF All Access will provide you with your required materials digitally at a reduced price and the ability to pay using your student account. This option

will be available starting 1 week prior to the semester starting and ending 3 weeks after the first day of class."

- Software: MATLAB Student Version (<mark>any recent version</mark> should be fine)

You may consider using UFApps to access a number of popular software applications for "free" including Matlab at: http://info.apps.ufl.edu/

Matlab is also available for purchase and download at http://www.mathworks.com/academia/student_version/index.html

Additional Recommended Materials

None.

Course Outline:

Part 1   Modeling, Computers, and Error Analysis

Mathematical Modeling

Numerical Methods & Problem Solving

Numerical Differentiation

Roundoff and Truncation Errors

Part 2   Root Finding

Roots: Bracketing Methods

Roots: Open Methods

Part 3   Linear Algebraic Equations and Matrices

Linear Algebraic Equations and Matrices

Gauss Elimination

LU Factorization

Matrix Inverse and Condition

Iterative Methods

Nonlinear system of equations

Eigenvalues & eigenvectors

Part 4   Curve Fitting

Linear Regression

General Linear Least-Squares and non-linear Regression

Polynomial Interpolation

Part 5   Numerical Integration

Numerical Integration based on given data

Numerical Integration based on given Functions

Part 6   Fourier Analyses

Fourier Series

Part 7   Ordinary Differential Equations

Initial Value Problems

Adaptive Methods and Stiff Systems

Attendance Policy, Class Expectations, and Make-Up Policy

Regular class attendance is expected. This course is being presented in an online, asynchronous format. In this format, class attendance constitutes watching the recorded video lectures and completing any HWs and a project assigned for completion prior to the due date.

Late HW and makeup exams are only allowed for students with documented circumstances consistent with UF policy. Students must contact the instructor as soon as possible to provide documentation and request a make-up exam. Excused absences must be consistent with university policies in the undergraduate catalog and require appropriate documentation. For more information on UF policies see
https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx

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. Pease 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 three during-term exams during the semester. They will be given in the evenings in order to coordinate two sections that I am teaching. 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)   Exams will be given through Honorlock system via Canvas e-learning.

iii)   Before the first exam, we will conduct some Honorlock trial tests so that everyone becomes familiar with the entire process from signing in to submitting the finished "test" before taking the first actual exam.

iv)   For redundancy purpose, for each exam you will need to submit your scanned exam papers twice: first one through Honorlock in the time window controlled strictly by Honorlock system and the second one through regular Canvas HW submission mechanism (I will create a special assignment for each exam so you can turn your work in).

v)   All the exam grading will be done on Canvas just like the way each HW is graded.

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

vii) NO CELL PHONE (or anything that can store formulae) is allowed during each 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 (rwmei@ufl.edu) 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 TA/grader 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 email me or call 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 the end of semester to ask for extra-credit work.

Evaluation of Grades

- Homework will be assigned regularly during the semester.

- One course project will be assigned.

- Three during-term exams will be given in the evening

Assignment		% of Final Grade
Homework		15%
Project (1)		7 %
Exam 1	Wed, 9/30/2020	26%
Exam 2	Wed, 10/28/2020	26%
Exam 3	Wed, 12/9/2020	26%

- **The time for each exam will be 8:20-10:25 pm.**
- **100 min is for exam. The rest is for logistics.**

Grading Policy

Percent	Grade	Grade Points
90 - 100	A	4.00
87 - 89	A-	3.67
84 - 86	B+	3.33
80 - 83	B	3.00
77 - 79	B-	2.67

74 - 76	C+	2.33
70 - 73	C	2.00
68 - 69	C-	1.67
65 - 67	D+	1.33
62 - 64	D	1.00
59 - 61	D-	0.67
0 - 59	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
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/.

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://www.dso.ufl.edu/sccr/process/student-conduct-honor-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.

A violation of the honor code will result in academic sanctions (typically a failing grade assigned for the course) and further disciplinary action.

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
• Robin Bielling, Director of Human Resources, 352-392-0903, rbielling@eng.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 and Copyrighted Material
All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use and the use of copyrighted material. 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: http://registrar.ufl.edu/catalog0910/policies/regulationferpa.html

Campus Resources:

<u>Health and Wellness</u>

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: http://www.counseling.ufl.edu/cwc, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

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/.

<u>Academic Resources</u>

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

Career Resource Center, Reitz Union, 392-1601. Career assistance and counseling. https://www.crc.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://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf.

On-Line Students Complaints: http://www.distance.ufl.edu/student-complaint-process.