Numerical Methods of Engineering Analysis I
EGM 6341

Sections 12131,12132, 12133, 13475

Class Periods: MWF **4** (10:40 am to 11:30 am)

Lectures will be delivered via recorded Zoom videos

Academic Term: Spring 2021

When this syllabus is modified during the semester

you will be notified and the revised syllabus will be posted.

Instructor:

Dr. Renwei Mei

Room: Zoom video

Email: rwmei@ufl.edu;

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

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

Office Hours: MWF 1:15 -2:15 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).

Catalog Description

Finite-difference calculus; interpolation and extrapolation; roots of equations; solution of algebraic equations; eigenvalue problems; least-squares method; quadrature formulas; numerical solution of ordinary

differential equations; methods of weighted residuals. Use of digital computer.

Course Pre-Requisites & Co-requisites

Requisites: EGM 4313 or equivalent.

Course Objectives:

The objective of the course is to introduce a broad range of numerical methods for solving mathematical problems that will be encountered in engineering fields. The emphasis is on a thorough understanding of the derivation, analyses, and use of these numerical methods. See course outline below for detailed coverage.

Materials and Supply Fees

None

Required Textbooks and Software

Textbook: An Introduction to Numerical Analysis, 2nd Ed, Wiley, by Kendall E. Atkinson ISBN 0471624896

References: An Introduction to Numerical Analysis, by F.B. Hildebrand

Detailed Lecture Notes and worked out examples will be available for each chapter.

Software: MATLAB Student Version (any recent version 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/

Course Outline:

1. Introduction

Math review (mean value theorems, Taylor series expansion, Fourier transform)
Computer Arithmetic and Errors (roundoff error, truncation error, floating point arithmetic significant digits, absolute and relative errors, error propagation)

2. **Root finding**
   Bisection method, Newton's method, secant method, method of false position, successive iteration method, repeated roots.
3. **Solving sets of linear equations**
   Matrix review, norm, Gauss elimination and Gauss-Jordan method, L-U decomposition, Determinant and matrix inversion, condition number, iterative methods.
4. **Interpolation methods**
   Method of undetermined coefficient, Lagrangian interpolation, Newton's divided difference, finite difference, error detection in data, interpolation error, Hermite interpolation, cubic spline, least square method.
5. **Approximation of functions**
   Weierstrass theorem, minimax approximation, least square approximation, orthogonal polynomials, Gram-Schmidt theorem.
6. **Numerical integration and differentiation**
   Derivatives from difference tables,
   Newton-Cotes Integration Formulae (mid point rule, trapezoidal rule, Simpson's rules, Romberg integration, Richardson extrapolation, Gaussian quadrature, Gauss-Hermite quadrature, imperfect integral.
7. **Numerical methods for initial value problems**
   Taylor series expansion for ODE, Euler & modified Euler methods, Runge-Kutta method and adaptive method, multi-step methods, systems of equations and high-order equations.
8. **Numerical methods for one-D boundary value problem**
   Shooting Method, finite fifference method, derivative boundary condition, collocation method, Galerkin Method.

9. Numerical methods for one-D unsteady heat equation & wave equation

KDV-Burgers equation and roles of convection, diffusion and dispersion; explicit and implicit finite difference method for parabolic equations; von Neumann stability analysis and growth factor; truncation error and accuracy; upwind difference scheme for wave equation; truncation error and modified PDEs.

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 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.
No early exam will be given to ANY student for any reason.

HW:

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

ii) For each assigned problem, 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. Your homework must be neatly written and formatted. Before you submit your work to Canvas, check the quality of your scanned file. Illegible work will not be graded.

iv) Submit your completed homework as a *single* file to Canvas course website.

Exams:

i) There will be a midterm exam and a final exam. The mid-term exam will be given in the evening so that you will have sufficient time to complete the exam problems. 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 an optional Honorlock trial test so that everyone becomes familiar with the entire process from signing in to submitting the finished "test" before taking the actual midterm exam. If everyone is already familiar with Honorlock, we will not hold trial test. Please email me about your familiarity with the Honorlock system.

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 the 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.

vii) The exam problems will require written response involving derivation and calculations. The emphasis of the exams will be to test your understanding, not on formulaic repetition.

viii) Some problems may be taken directly from the homework problems or from lecture discussions with some modifications.

ix) You must write your own homework.

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

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 talk to me on Zoom. 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

15% Homework: A set of problems will be assigned and collected regularly.
The solution will be posted.
35% Mid-term exam
50% Final Exam (cumulative)

Assignment		**% of Final Grade**
Homework		15%
Mid-term Exam	Wed, 3/3/2021 **8:20-10:35 pm**	35%
Final Exam	Thursday, 4/29/2021 12:30 - 2:59 pm	50%

- **The time for mid-term exam will be 8:20-10:35 pm.**
  100 min is for exam; the rest is for Honorlock logistics.

- **The time for final exam is 120 min; the rest is for Honorlock logistics.**
  (If nobody has another final exam at 3 pm on 4/29, I can give the entire class an extra 5-10 min for handling Honorlock logistis. Please let me know ASAP.)

LETTER GRADE:

	A: 90-100,	A-: 87-89;
B+: 84-86,	B: 80-83,	B-: 77-79;
C+: 74-76,	C: 70-73,	C-: 67-69;
D+: 64-66;	D: 60-63,	D-: 55-59;
E: 0-54		

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:

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: 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/.

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 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.