Introduction to Numerical Methods of Engineering Analysis

EGM 3344 Section 03FB  Class# 12099

Class Periods:  MWF 7 (1:55 pm to 2:45 pm)
Class Location:  CSE E121

EGM 3344 Section 1589  Class# 12101

Class Periods:  MWF 9 (4:05 pm to 4:55 pm)
Class Location:  WEIL 270

Academic Term:  Spring 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; office phone: 352-392-0888
(All emails regarding the course should be sent to me via e-learning)
Office Hours:  MW 10:30 -12:00 am @ 127 NEB

Teaching Assistant:

Mr. Bo Han Huang (Office Hours: 11:30-12:30 Friday @ 331 MAEB)
Mr. Ninad Gaikwad (Office Hours: 1:30-2:30 Tuesday @ 109 NEB)
Mr. Linwei Mou (Office Hours: 10:00-11:00 am Thursday @ 5th floor of Nuclear Science Building; see picture below for details)
Location: 5th floor on Nuclear Science Building, East end of the Hallway, next to the stair. There are two long tables next to glass windows:

Grader:

Mr. Zheng Ren

Catalog Description


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):**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Coverage*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics</td>
<td>High</td>
</tr>
<tr>
<td>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</td>
<td></td>
</tr>
</tbody>
</table>
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**


- 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/

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
Splines and Piecewise Interpolation

Part 5 Numerical Integration
Numerical Integration based on given data
Numerical Integration based on given Functions

Part 6 Fourier Analyses
Fourier Series
Fourier Integral
Fourier Transformation

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. 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. 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: To receive full credit, you will be required to complete all assigned problems AND to follow the homework formatting instructions provided in the course canvas site. No partial credit will be given for incorrect or incomplete solutions.

Exams: Exams will be closed-book and closed notes, but you will be allowed to bring ONE piece of 8.5x11” sheet of paper for each hourly exam.

NO CELL PHONE (or anything that can store formulae) is allowed during the exams.

NO programmable calculator is allowed during exams.

Only scientific calculators (such as TI-36, Casio,…) are allowed during exams.

Exam 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. A study group would be an
excellent place to discuss the solution process to each problem in preparation for exams. The emphasis of the exams will be to test your understanding, not on formulaic repetition, so expect the exam problems to be challenging and test your grasp of the methods taught in the class.

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

**Evaluation of Grades**

- Homework will be assigned regularly during the semester.
- Class participation will be a factor. For individuals in the gray area between two grades, performance on the homework and attendance will be used to make the final decision.
- 4 hourly exams will be given.

<table>
<thead>
<tr>
<th>Assignment</th>
<th>% of Final Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homework</td>
<td>10%</td>
</tr>
<tr>
<td>Projects (2)</td>
<td>5% + 5%</td>
</tr>
<tr>
<td>Exam 1</td>
<td>Mon 2/3/2020</td>
</tr>
<tr>
<td>Exam 2</td>
<td>Wed 2/26/2020</td>
</tr>
<tr>
<td>Exam 3</td>
<td>Wed 4/1/2020</td>
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<tr>
<td>Exam 4</td>
<td>Wed 4/22/2020</td>
</tr>
</tbody>
</table>

• The location and time for each exam will be announced later
Grading Policy

<table>
<thead>
<tr>
<th>Percent</th>
<th>Grade</th>
<th>Grade Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>90 - 100</td>
<td>A</td>
<td>4.00</td>
</tr>
<tr>
<td>87 - 89</td>
<td>A-</td>
<td>3.67</td>
</tr>
<tr>
<td>84 - 86</td>
<td>B+</td>
<td>3.33</td>
</tr>
<tr>
<td>80 - 83</td>
<td>B</td>
<td>3.00</td>
</tr>
<tr>
<td>77 - 79</td>
<td>B-</td>
<td>2.67</td>
</tr>
<tr>
<td>74 - 76</td>
<td>C+</td>
<td>2.33</td>
</tr>
<tr>
<td>70 - 73</td>
<td>C</td>
<td>2.00</td>
</tr>
<tr>
<td>68 - 69</td>
<td>C-</td>
<td>1.67</td>
</tr>
<tr>
<td>65 - 67</td>
<td>D+</td>
<td>1.33</td>
</tr>
<tr>
<td>62 - 64</td>
<td>D</td>
<td>1.00</td>
</tr>
<tr>
<td>59 - 61</td>
<td>D-</td>
<td>0.67</td>
</tr>
<tr>
<td>0 - 59</td>
<td>E</td>
<td>0.00</td>
</tr>
</tbody>
</table>

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 requesting accommodations should first register with the Disability Resource Center (352-392-8565, https://www.dso.ufl.edu/drc) by providing appropriate documentation. Once registered, students will receive an accommodation letter to present to the instructor when requesting accommodation. Students with disabilities should follow this procedure 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/scrr/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. A violation of the honor code will result in academic sanctions (typically a failing grade assigned for the course) and further disciplinary action. If you have any questions or concerns, please consult with the instructor or TAs in this class.

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](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/](http://www.police.ufl.edu/).

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*Academic Resources*

**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](https://lss.at.ufl.edu/help.shtml).

**Career Resource Center**, Reitz Union, 392-1601. Career assistance and counseling. [https://www.crc.ufl.edu/](https://www.crc.ufl.edu/).

**Library Support**, [http://cms.uflib.ufl.edu/ask](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/](https://teachingcenter.ufl.edu/).
**Writing Studio, 302 Tigert Hall**, 846-1138. Help brainstorming, formatting, and writing papers. [https://writing.ufl.edu/writing-studio/](https://writing.ufl.edu/writing-studio/).

**Student Complaints Campus:**