

## **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](mailto: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 @ 5<sup>th</sup> floor of  
Nuclear Science Building; see picture below for details)

**Location: 5<sup>th</sup> 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***

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):***

<b>Outcome</b>	<b>Coverage<sup>*</sup></b>
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
- 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](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.

<b>Assignment</b>		<b>% of Final Grade</b>
Homework		10%
Projects (2)		5% + 5 %
Exam 1	Mon 2/3/2020	20%
Exam 2	Wed 2/26/2020	20%
Exam 3	Wed 4/1/2020	20%
Exam 4	Wed 4/22/2020	20%

- The location and time for each exam will be announced later



### ***Grading Policy***

<b>Percent</b>	<b>Grade</b>	<b>Grade Points</b>
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***

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/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. 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](mailto: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 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](https://www.dso.ufl.edu/documents/UF%20Complaints%20policy.pdf).

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