



EGM 3344 | Introduction to Numerical Methods of Engineering Analysis

Class Number: 13787

Instructor Information

Jonathan Brooks

Course Details

Catalog Description: Methods for numerical solution of mathematical problems with emphasis on engineering applications using MATLAB. Includes roots, optimization, linear algebraic equations, matrices, curve fitting, differentiation, integration and ordinary differential equations.

Pre- and Co-Requisites: Prereq: MAC 2313 and COP 2271; Coreq: MAP 2302.

Credit Hours: 3

Course Fees: \$0.00

Required Materials

MATLAB & SIMULINK STUDENT VERSION SOFTWARE

ISBN: 9780989614023

Authors: THE MATHWORKS

Publisher: THE MATHWORKS

Edition: ANY RECENT

All Access: This course does not use UF All Access

Recommended Materials

APPLIED NUMERICAL METHODS W/MATLAB: FOR ENGINEERS & SCIENTISTS

ISBN: 9780073397962

Authors: STEVEN C. CHAPRA

Publisher: MCGRAW HILL

Edition: ANY RECENT

All Access: This course does not use UF All Access

A Note on Materials

Any version of the book will suffice. You have the option to use UF Apps to access MATLAB, but I recommend purchasing the student version of MATLAB. It is much less of a hassle than UF Apps and worth the investment. I also recommend purchasing the version that comes with Simulink and various toolboxes. We will not need them for this class, but you may need them for future classes. For example, you will need Simulink if you take Controls with me. I speak from experience as a former undergraduate student at the University of Florida.

Course Goals and Objectives

The goal of EGM 3344 is to teach you how to apply computational methodologies to solve engineering problems when no closed-form, analytical solution exists. Achievement of this goal requires learning the basics of structured programming as well as learning how to combine engineering knowledge, judgment, and intuition to develop reasonable approximations through the engineering modeling process. Because mathematical judgment and approximations are involved, the material in this course will be somewhat more open-ended than the material covered in other courses. Emphasis will be placed on understanding the 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. This approach is taken since understanding how numerical methods work is essential for choosing the correct method and understanding its limitations. At the same time, the existence of commercial numerical libraries makes it inefficient and unnecessary for students to re-develop complex existing numerical routines.

Expectations and Student Learning Outcomes

By the end of this course, you should be able to:

1. Numerical methods: Understand the most common numerical methods used in engineering analysis, when to use each method, and how to implement basic methods in a structured manner using MATLAB's programming language.
2. Numerical accuracy: Estimate the amount of error inherent in different numerical methods.

3. Numerical efficiency: Assess the efficiency of a selected numerical method when more than one option is available to solve a certain class of problem.
4. Numerical stability: Understand the convergence properties and limitations of different numerical methods.

Methods of Evaluation

Methods of Evaluation

Assignment	Percentage of Final Grade
Homework	30%
Exam 1	35%
Exam 2	35%

Grading Scale

Letter grade and percentage

Letter	Percentage Value
A	94 - 100%
A -	90 - 93%
B +	87 - 89%
B	83 - 86%
B -	80 - 82%
C +	77 - 79%
C	73 - 76%
C -	70 - 72%
D +	67 - 69%
D	63 - 66%
D -	60 - 62%
E	59% and below

Course Schedule

Tentative Course Schedule

Module	Topics	Book Chapters	Estimated Assignments
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Module	Topics	Book Chapters	Estimated Assignments
Introduction	Modeling, Euler's method, round-off error, Taylor series, truncation error	1-4	HW1, HW2
Root-Finding and Optimization	Bisection method, false-position method, Newton-Raphson method, secant method; gradient descent method; Newton's method of optimization	5-6 for root-finding; optimization not in the book	HW3, HW4
Linear Algebra	Gauss elimination, LU factorization, matrix inverse, norms, condition number, eigenvalues and eigenvectors	8-11, 13	HW5, Exam 1
Iterative Methods for Systems of Equations	Jacobi method, Gauss-Seidel method, general Newton-Raphson method	12	HW6
Least Squares	Linear least squares, nonlinear least squares	14-15	HW7
Introduction to Fourier	Fourier analysis	16	HW8
Curve-Fitting without Least Squares	Polynomial interpolation, cubic splines	17-18	

Module	Topics	Book Chapters	Estimated Assignments
Numerical Integration and Differentiation	Newton-Cotes formulas, higher-order finite-difference approximations, Romberg integration	19-21	
Initial-Value Problems	Runge-Kutta methods	22	HW9

University Policies and Resources

Information about grading policies, support for students with disabilities, course evaluations, the Honor Code, and other course policies and campus resources can be found on the [Syllabus Policies page](#).

Attendance Policy

Excused and Unexcused Absences

Students may only participate in classes if they are registered officially or approved to audit with evidence of having paid audit fees. The Office of the University Registrar provides official class rolls to instructors.

Students are responsible for satisfying all academic objectives as defined by the instructor. Absences count from the first-class meeting.

Acceptable reasons for absence from or failure to engage in class include illness; Title IX-related situations; serious accidents or emergencies affecting the student, their roommates, or their family; special curricular requirements (e.g., judging trips, field trips, professional conferences); military obligation; severe weather conditions that prevent class participation; religious holidays; participation in official university activities (e.g., music performances, athletic competition, debate); and court-imposed legal obligations (e.g., jury duty or subpoena). Other reasons (e.g., a job interview or club activity) may be deemed acceptable if approved by the instructor.

For all planned absences, a student in a situation that allows an excused absence from a class, or any required class activity must inform the instructor as early as possible prior to

the class. For all unplanned absences because of accidents or emergency situations, students should contact their instructor as soon as conditions permit.

Students shall be permitted a reasonable amount of time to make up the material or activities covered during absence from class or inability to engage in class activities because of the reasons outlined above.

If a student does not participate in at least one of the first two class meetings of a course or laboratory in which they are registered, and they have not contacted the department to indicate their intent, the student can be dropped from the course. Students must not assume that they will be dropped, however. The department will notify students if they have been dropped from a course or laboratory.

The university recognizes the right of the instructor to make attendance mandatory and require documentation for absences (except for religious holidays), missed work, or inability to fully engage in class. After due warning, an instructor can prohibit further attendance and subsequently assign a failing grade for excessive absences.

Religious Holidays Guidelines

At the University of Florida, students and faculty work together to allow students the opportunity to observe the holy days of their faith. A student should inform the faculty member of the religious observances of their faith that will conflict with class attendance, with tests or examinations, or with other class activities prior to the class or occurrence of that test or activity. The faculty member is then obligated to accommodate that particular student's religious observances. Because students represent a myriad of cultures and many faiths, the University of Florida is not able to assure that scheduled academic activities do not conflict with the holy days of all religious groups. Accordingly, individual students should make their need for an excused absence known in advance of the scheduled activities.

The Florida Board of Education and state law govern university policy regarding observance of religious holidays.

Guidelines

- Students, upon prior notification to their instructors, shall be excused from class or other scheduled academic activity to observe a religious holy day of their faith.
- Students shall be permitted a reasonable amount of time to make up the material or activities covered in their absence.

- Students shall not be penalized due to absence from class or other scheduled academic activity because of religious observances.

If a faculty member is informed of or is aware that a significant number of students are likely to be absent from class because of a religious observance, the faculty member should not schedule a major exam or other academic event at that time.

A student who is to be excused from class for a religious observance is not required to provide a second party certification of the reason for the absence. Furthermore, a student who believes that they have been unreasonably denied an education benefit due to religious beliefs or practices may seek redress through the student grievance procedure.

Absence due to Illness

A student who is absent from class or any required class-related activity because of illness should contact their instructor, if feasible, as early as possible prior to the missed class or activity.

Students shall be permitted a reasonable amount of time to make up the material or activities covered during an excused absence.

Students should contact their college by the deadline to drop a course for medical reasons. Students can petition the Dean of Students Office to drop a course for medical reasons. The university's policy regarding medical excuse from classes is maintained by the Student Health Care Center.

Twelve-Day Rule

Students who participate in university-sponsored athletic or scholarly activities are permitted to be absent 12 scholastic days per semester without penalty. A scholastic day is any day on which regular class work is scheduled as defined in the approved university calendar. [More Info](#)

The student or student's advisor must notify the instructor as early as possible prior to the anticipated absence to allow ample time for accommodations. Instructors must be flexible and not penalize students when re-scheduling during-term and final exams, class assignments, and other required activities and must follow the UF Attendance Policy herein and UF Examination Policies. As noted in the UF Examination Policies, during-term exams should be re-scheduled no later than before the end of the semester, while final exams no later than 90 days after the originally scheduled exam time. However, instructors are encouraged to re-schedule final and during-term exams, assignments, and other activities as

soon as possible after the last day of the absence and must not penalize the student in any way. [More Info](#)

A group's schedule that requires absence of more than 12 scholastic days should be adjusted so that no student is absent from campus more than 12 scholastic days. Students who previously have been warned in writing by their instructor about the impact of absences on their individual class performance should not incur additional absences, even if they have not been absent 12 scholastic days. The student is responsible to maintain satisfactory academic performance and attendance.

Course Policies and Resources

Attendance

- Regular class attendance is expected although not explicitly included in the grade evaluation.
- The course will be delivered in a hybrid format. A Zoom conference will be created for each lecture for students to attend remotely if they do not wish to come to the classroom.

Homework

- HW will be posted on Canvas along with its due date.
- HW will be turned in on Canvas.
- Some or all assigned problems will be graded for each assignment. You are required to complete all assigned problems.
- If you do not agree with the grading of a HW problem, you will have one week from the date the HW is returned to submit a written argument of why you think the grade should be higher. However, the final decision will remain the instructor's.

Exams

- Exams will be open-book and open-notes
- Exams will be conducted online via Honorlock. A webcam is required for Honorlock.
- An Honorlock calculator will be provided. No other calculators 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 as possible. The emphasis of the exams will be to test your understanding, not on formulaic repetition, so expect the exam problems to be challenging and to test your grasp of the methods taught in the class.

- Makeup exams are only allowed for students with extreme, documented circumstances. 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.
- 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 argument of why you think the grade should be higher. However, the final decision will remain the instructor's.

E-learning course web site (Canvas)

- Students are expected to check Canvas on a regular basis for up-to-date course information. This may include changes to homework assignment due dates, exam schedules, etc.

Workload

- Numerical Methods requires a great deal of programming, and completing the assignments is the only way to solidify your understanding of the material. The lectures will introduce the material, but you should expect to spend a significant amount of time on the homework; this is where the real learning takes place.

Late and Make Up Work Policy

Late HW will be accepted up to 24 hours after the due date with a maximum-grade penalty of 20 points. That is, your grade will be rounded down to an 80. If this sounds severe, turn in your homework on time. If you have an absolute doomsday of a week, this is your safety valve. Hardship cases will be considered on an individual basis and only if the instructor has been contacted before the due date of the assignment. Students with hardship cases (e.g., due to medical problems) will be referred to the Dean of Students office, which will perform a background investigation to determine if the hardship is legitimate.