The University of Texas at Austin
Department of Aerospace Engineering and Engineering Mechanics

Engineering Computation

COE 311K - Unique No. 13525

Fall 2019

Instructor:	Gurpreet Singh Email: gurpreet@utexas.edu Office: POB 6.242 Office Hours: Th 3:00–5:00 p.m.
Teaching Assistants:	
Geonyeong Lee	Email: geon@utexas.edu Office: POB 3.128 Office Hours: Mon 10 a.m. - 12 p.m.
Jon Wittmer	Email: jonathan.wittmer@utexas.edu Office: POB 3.128 Office Hours: Tue 10 a.m. - 12 p.m.
Jau-uei Chen	Email: chenju@utexas.edu Office: POB 3.128 Office Hours: Tue 2 p.m. - 5 p.m.
Times:	MWF 9:00 a.m.-10:00 a.m.
Classroom:	ASE 1.126
Notes:	Canvas messages will be checked twice a day. Email copying all TAs for fastest response. Please write COE 311K in the subject line of the email.

Course reference

"Applied Numerical Methods with MATLAB" Steven C. Chapra, McGraw Hill, 4th edition (or earlier), 2018.

Course prerequisites

I expect you to know the basics of linear algebra. Previous programming experience (preferably with Matlab) is recommended.

Course objectives

The course has two primary goals: (a) to provide you with the basic elements of programming using MATLAB, and (b) to introduce you to simple numerical methods for the solution of mathematical modeling problems that typically arise in a variety of engineering disciplines. Through theory and applications, the course aims at training you in thinking in a structured manner about solutions to engineering/mathematical problems.

Course content overview/description

Numerical methods are at the core of computational modeling techniques for solving engineering problems. The classical hierarchy for attaining such solutions includes four distinct steps: (i) observations; (ii) condensation of of observations as mathematical models; (iii) solution of the mathematical models using numerical methods, and verification against manufactured solutions; (iv) validation of the obtained results with observations.

Numerical computations are an integral part of modern day life: when we hail a car, travel in efficient and safe aircrafts, avail medical treatments, use appliances at home. All of these developments have been made possible by solving complicated mathematical models using numerical methods on compute machines. In the last few decades, affordable computing power combined with engineering problem solving and mathematical modeling has led to deployment of technologies that were considered science fiction.

As the next generation of problem solvers, it is necessary that all of us know the basic elements of mathematical modeling, numerical solution techniques, and programming to encumber future accomplishments. This introductory course in numerical methods and programming aims at exposing you to the fundamentals of numerical methods and programming so that as engineers and problem solvers you will be able to participate confidently in shaping our future.

Homework Assignments

Assignments will be posted, on an average, every week on Canvas. You should expect approximately 11$\sim$13 homework assignments over the duration of this course. Assignments are due on the date marked on the assignment sheet, mostly by Friday noon, unless explicitly stated otherwise. Your assignments must clearly articulate the concepts and must be legible to assist the grading process. LATE ASSINGMENTS WILL NOT BE ACCEPTED. Students are strongly encouraged to discuss course and homework topics among themselves, since such discussions are an important part of the learning process. However, each student must carry out these assignments independently. Working on assignments (programming or otherwise) constitutes possibly the best way for digesting the material and learning concepts. I strongly recommend all of you to consistently complete and submit the assignments throughout the semester. I expect the students to adhere to reasonable presentation standards without anyone having to describe or define these standards for you.

Exams

There will be two midterm exams, approximately two hours each, and one final exam. The exams will cover the topics immediately preceding the exam. The final exam is accumulated. There will be NO MAKE-UP EXAM. Alternative dates for the exams will be arranged only for students with documented medical emergencies. All exams will be conducted with closed books and closed notes, unless otherwise stated prior to the exam.

Grading policy

Homework	30 %	weekly - due on Fridays by noon.
Exam 1	20 %	on Tue, 10/08/2019 - 9:00 a.m. - 11:00 a.m. - Room: TBD
Exam 2	20 %	on Fri, 11/08/2019 - 9:00 a.m. - 11:00 a.m. - Room: TBD
Final exam	30 %	TBD

Letter grades will be assigned as follows. I reserve the right to change these bounds. Any adjustment to the bounds will depend on the class's performance.

A	for	$90 < G \leqslant 100$
A-	for	$87 < G \leqslant 90$
B+	for	$84 < G \leqslant 87$
B	for	$80 < G \leqslant 84$
B-	for	$77 < G \leqslant 80$
C+	for	$74 < G \leqslant 77$
C	for	$70 < G \leqslant 74$
C-	for	$67 < G \leqslant 70$
D+	for	$64 < G \leqslant 67$
D	for	$60 < G \leqslant 64$
D-	for	$57 < G \leqslant 60$
F	for	$G \leqslant 57$

Attendance and participation Regular attendance is expected. In my experience, there is a high correlation between a low course grade or course failure, and scarce class attendance.

Important: I reserve the right to give a Q or F grade, or otherwise terminate, a student's class registration for any reason that I believe to be disruptive to the learning process of the student or of the class.

A student who misses examinations, for the observance of a religious day should inform the instructor as far in advance of the absence as possible, so that arrangements can be made to complete an assignment within a reasonable time after the absence.

Class format

Class will consist of 3 one hour lectures each week. I intend to use all 3 hours allocated to the course for lectures, which, however, will include, on occasion, the in-class solution of example problems.

Course website

Information about the course, the syllabus, helpful materials, homework assignments and homework solutions, and any handouts will be posted regularly on the Canvas website (http://courses.utexas.edu). You will also be able to monitor your progress in the course by reviewing your assignments/exams grades.

Special accommodation

The University of Texas at Austin provides, upon request, appropriate academic adjustments for qualified students with disabilities. Any student with a documented disability (physical or cognitive) who requires academic accommodations should contact the Services for Students with Disabilities area of the Division of Diversity and Community Engagement at 471-6259 as soon as possible to request an official letter outlining authorized accommodations. For more information, contact that office at 471-6259, Video Phone 410-6644, or http://www.utexas.edu/diversity/ddce/ssd.

Important: You need to inform the instructor at the beginning of the semester (first week), if due to this special case, you are allowed to skip the exams, require more time for the tests, etc.

Course/Instructor evaluation

An evaluation of the course and instructor will be conducted at the end of the semester using the approved UT Course/Instructor evaluation forms. I strongly encourage you to please complete it.

Course add/drop policy

From the 1st through the 12th class day, an undergraduate student can drop a course via the web and receive a refund, if eligible. From the 13th through the university's academic drop deadline, a student may Q drop a course with approval from the Dean, and departmental advisor.

Scholastic dishonesty

All students are responsible for upholding the University rules on scholastic dishonesty. Students who violate University rules on scholastic dishonesty are subject to disciplinary penalties, including the possibility of failure in the course and/or dismissal from the University. Since such dishonesty harms the individual, all students, and the integrity of the University, policies on scholastic dishonesty will be strictly enforced. For further information, visit the Student Judicial Services web site http://deanofstudents.utexas.edu/sjs/, and the General Information Catalog information http://catalog.utexas.edu/general-information/.

University policies

All other university policies not explicitly included on this syllabus can be found on the General Information Catalog: http://catalog.utexas.edu/general-information/.

Notes on safety and security

Occupants of buildings on The University of Texas at Austin campus are required to evacuate buildings when a fire alarm is activated. Alarm activation or announcement requires exiting and assembling outside (across the bridge).

- Familiarize yourself with all exit doors of each classroom and building you may occupy. Remember that the nearest exit door may not be the one you used when entering the building.
- Students requiring assistance in evacuation shall inform their instructor in writing during the first week of class.
- In the event of an evacuation, follow the instruction of faculty or class instructors. Do not re-enter a building unless given instructions by the following: Austin Fire Dept., The University of Texas at Austin Police Dept., or Fire Prevention Services office.
- Behavior Concerns Advice Line (BCAL) 512-232-5050. For more information visit the BCAL website: http://www.utexas.edu/safety/bcal/
- Link to information regarding emergency evacuation routes and emergency procedures can be found at: www.utexas.edu/emergency

Course schedule

Topic	**Section**
Mathematical modeling	Ch. 1
Review MATLAB	Ch. 2,3
Numerical error	Ch. 4
Roots	Ch. 5
Roots	Ch. 6
Linear systems of equations	Ch. 8
Gauss elimination	Ch. 9
LU factorization	Ch. 10
Matrix inverse*	Ch. 11
Iterative methods*	Ch. 12
Eigenvalues	Ch. 13
Linear regression	Ch. 14
Nonlinear regression	Ch. 15
Polynomial interpolation	Ch. 17
Piecewise interpolation	Ch. 18
Numerical integration methods	Ch. 19
Numerical integration of functions	Ch. 20
Numerical differentiation	Ch. 21
Solving ODEs: IVP	Ch. 22
Optimization*	Ch. 7
Solving ODEs: Adaptive methods*	Ch. 23
Solving ODEs: BVP*	Ch. 24

*: time permitting.

Relationship of Course to Program Outcomes

This course contributes to the ABET Criterion 3 student outcomes that took effect with the Fall 2019 semester. For more information, see Criteria for Accrediting Engineering Programs, 2019 – 2020 at https://www.abet.org/accreditation/accreditation-criteria/criteria-for-accrediting-engineering-programs-2019-2020/

STUDENT OUTCOME	
1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	√
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	
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	
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	