

# Matrix and Numerical Methods in Systems Engineering

ESI 4327C Section 2629  
Academic Term: Fall 2018

## **Instructor:**

Dr. Ehsan Salimi

Email Address: [e.salimi@ufl.edu](mailto:e.salimi@ufl.edu)

Office location: 378 Weil Hall

Office Hours: Monday, Wednesday 2:30 pm-3:30pm (or by appointment)

## **Teaching Assistant:**

Arsenios Tsokas, Office location: 406 Weil Hall, Email address: [artsokas@ufl.edu](mailto:artsokas@ufl.edu), Office hours: Monday 10 am-12 pm

## **Course Description**

Catalog Description: Theory and application of vector, matrix and other numerical methods to systems problems. Simultaneous linear equations, characteristic values, quadratic forms, error analysis, use of series, curve fitting, nonlinear equations, discrete methods. The laboratory sessions will emphasize on numerical solutions using MATLAB/Python.

## **Course Pre-Requisites / Co-Requisites**

MAC 2313, MAP 2302 with minimum grades of C

## **Course Objectives**

- To understand the underlying fundamental ideas behind numerical methods and the concepts behind the techniques presented in the course.
- To grasp the analysis of algorithms, computational complexity, and other concepts and modern developments in numerical methods
- To develop facility with the techniques themselves, and to be able to solve small size problems analytically
- To learn how to implement the methods in the MATLAB/Python programming environment (ability to program in at least one high level language such as C, C++, FORTRAN, VB, etc. will be useful, but is not a requirement).

## **Meeting Times and Location**

MW| Periods 10-11 (5:10 PM – 7:05 PM), [FLG 0230](#)

F| Period 10 (5:10 PM – 6:00 PM), [FLG 0230](#)

## **Materials and Supply Fees**

N/A

## **Professional Component (ABET):**

This course teaches the basic concepts in the theory and applications of vector, matrix and other numerical methods to systems problems. Students will develop and enhance their ability to address various problems applying numerical methods and modern software (MATLAB/Python).

## **Relation to Program Outcomes (ABET):**

Outcome	Coverage*
a. an ability to apply knowledge of mathematics, science, and engineering	High
b. an ability to design and conduct experiments, as well as to analyze and interpret data	
c. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	

d. an ability to function on multidisciplinary teams	
e. an ability to identify, formulate, and solve engineering problems	
f. an understanding of professional and ethical responsibility	
g. an ability to communicate effectively	
h. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	
i. a recognition of the need for, and an ability to engage in life-long learning	
j. a knowledge of contemporary issues	
k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.	Medium

\*Coverage is given as high, medium, or low. An empty box indicates that this outcome is not part of the course.

### **Recommended Textbooks**

- Title: **Introduction to Linear Algebra**
- Author: Gilbert Strang
- Wellesley Cambridge Press, 5th edition
  
- Title: **Numerical Methods and Optimization: An Introduction**
- Authors: S. Butenko and P. Pardalos
- Chapman and Hall, 1st edition

### **Course Schedule (Tentative Schedule)**

The course Schedule is offered as a guide. This means that it is subject to change, depending on the pace of the class. The instructor might choose to cover parts of the curriculum more extensively, or give extensions to deadlines. The dates of the exams might be subject to change depending on the progress of the class.

<b>Week</b>	<b>Chapter/Book</b>	<b>Exam</b>
1	Introduction	
2	Vectors and Linear Systems	
3	Matrix and their properties	Q1 (Friday: Sep 7 )
4	Matrix Norms, Direct Methods for Linear Systems	
5	Direct Methods for Linear Systems	
6	Independence, basis, and dimension	<b>Exam 1 (Monday: Sep 24)</b>
7	Matrix Subspaces	
8	Eigenvalues and Eigenvectors	Q2 (Friday: Oct 12)
9	Numbers and Errors/ Introduction to MATLAB (Python)	
10	Iterative Methods for Linear Systems	<b>Exam 2 (Monday: Oct 22)</b>
11	Iterative Methods for Solving Nonlinear Equations	
12	Polynomial Interpolation	Q3 (Friday: Nov 9)
13	Numerical Integration	
14	Numerical Integration / <b>BREAK</b>	
15	Numerical Solutions of Differential Equations	MATLAB HW ( due: Nov 30)
16	Review and Exam	<b>Exam 3 (Wednesday: Dec 5)</b>

### ***Attendance Policy***

Attendance is very strongly encouraged - you are responsible for the announcements made in class. Students are expected to know the material covered in the prerequisite courses. When necessary, they are expected to relearn material from these courses on their own.

**This is not a course where you can do well on exams solely by blindly applying formulas.** In order to get the most out of the course, try to stay ahead. By the weekend, make sure you have at the least reviewed the material covered in the lectures and readings of the preceding week. In addition to reading, working out extra exercises on your own will help in improving your understanding of the material. With diligent practice, you can prepare yourself to the point where, on exams, instinct takes over and the problems seem straightforward.

### ***Exam Policy***

You are expected to be present without exception and to plan any travel around these dates accordingly. Medical emergencies are of course excluded if accompanied by a doctor's note. A note indicating that you were seen at the health center the day of the exam is not sufficient documentation of a medically excused absence from an exam. The note must say that you were medically unable to take the exam.

If you fail to take the exam on the assigned day and do not have a valid excuse, there will be no make-up exam and you will be given a zero (0) on the exam. Employment interviews, employer events, weddings, vacations, etc. are not excused absences.

### ***Evaluation of Grades***

Your performance in the course will be evaluated based on three in-class exams and regular quizzes, as follows:

- (a) Quiz: **15%**
- (b) Exam 1: **25%**
- (c) Exam 2: **25%**
- (d) Exam 3: **25%**
- (e) MATLAB Homework: **10%**

**Exam Grading Appeals:** Every effort will be made to ensure that grading is as objective and fair as possible. If you believe that there is an error in the grading, please submit, in writing, an appeal within one week of your exam being returned. However, please be advised that if you submit such an appeal, the entire exam will be regraded to ensure that all parts are properly graded. As such, your grade on the exam could increase or decrease based on the secondary grading.

### ***Grading Scale***

<b>Percent</b>	<b>Grade</b>	<b>Grade Points</b>
[93 - 100]	A	4.00
[90 - 93)	A-	3.67
[87 - 90)	B+	3.33
[83 - 87)	B	3.00
[80 - 83)	B-	2.67
[77 - 80)	C+	2.33
[73 - 77)	C	2.00
[70 - 73)	C-	1.67
[67 - 70)	D+	1.33
[63 - 67)	D	1.00
[60 - 63)	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 which must be presented 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 feedback on the quality of instruction in this course by completing online evaluations at <https://evaluations.ufl.edu/evals>. Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at <https://evaluations.ufl.edu/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.

### ***Software Use***

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. 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:**

If you or a friend is in distress, please contact [umatter@ufl.edu](mailto:umatter@ufl.edu) or 352 392-1575 so that a team member can reach out to the student.

**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](mailto: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_Complaints_policy.pdf).

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

1 LINEAR ALGEBRA 1.1 Solving a set of linear equations 1.2 Vectors and matrices 1.3 Fundamental subspaces 1.4 Orthogonality 1.5 Determinants 1.6 Eigendecomposition 1.7 Singular value decomposition 1.8 Total least squares. A Banach and Hilbert spaces. B the Karhunen-Loève transform. C Useful formulae. Bibliography. 1 1 2 6 9 14 15 19 21. 24.