

# Matrix and Numerical Methods in Systems Engineering

ESI3327C Section 5202

M,W,F, Period 3, 9:35 AM – 10:25 AM

## **Location:**

Zoom on Mondays

[WEIM 1094](#) on Wednesdays and Friday

**Academic Term:** Spring 2022

## **Instructor:**

Sima Sabahi

Email: [sima.sabahi@ufl.edu](mailto:sima.sabahi@ufl.edu)

Virtual Office Hours: Thursdays, 8:00 AM-10:00 AM (Zoom), or by appointment

## **Teaching Assistant**

Hailee Cono, Email: [haileecono@ufl.edu](mailto:haileecono@ufl.edu)

Office Hours: TBD

## **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 numerical solutions using MATLAB or 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.

## **Materials and Supply Fees**

None

## **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*
1. Ability to apply knowledge of mathematics, science, and engineering	High
2. Ability to design and conduct experiments, as well as to analyze and interpret data	
3. 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	
4. Ability to function on multidisciplinary teams	
5. Ability to identify, formulate, and solve engineering problems	
6. An understanding of professional and ethical responsibility	

7. An ability to communicate effectively	
8. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	
9. A recognition of the need for, and an ability to engage in lifelong learning	
10. A knowledge of contemporary issues	
11. 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.

### **Required Textbooks and Software**

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

### **Course 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.

Week	Topics	Assignments
1	Introduction, Vectors	
2	Vectors, Introduction to Matrix	
3	Matrix Operations, Matrix Properties	
4	Matrix Norms, Linear Systems	HW1
5	Direct Methods for Linear Systems	Exam 1
6	Direct Methods for Linear Systems	
7	Vector spaces and subspaces	
8	Independence, basis, and dimension	
9	Independence, basis, and dimension	
10	Matrix Subspaces, Eigenvalues, and Eigenvectors	HW2
11	Matrix Subspaces, Eigenvalues, and Eigenvectors	Exam 2
12	Numbers and Errors/ Introduction to MATLAB or Python	
13	Iterative Methods for Linear Systems	
14	Iterative Methods for Linear Systems/MATLAB or Python	
15	Iterative Methods for Solving Nonlinear Equations	HW3
16	Numerical Solutions of Differential Equations	Exam 3

### **Attendance Policy**

Attendance is not required; however, it is strongly recommended. Students will be responsible for all material covered in class.

### **Assignments**

**Homework (20%):** There will be three to four homework assignments throughout the semester. The material will be drawn from the textbook, powerpoints, and exercises thought during the class. Homework assignments must be done individually and their due dates will be announced in advance. Homework

assignments must be submitted by the due date and there will be a penalty (30%) for late homework submissions. Homework submitted 24 hours after the deadline will not be accepted.

**Exams (60%):** There will be three exams. Students needing a make-up exam due to schedule conflicts must provide documentation and notify the instructor at least one week before the day the exam is scheduled for. If you miss any exam due to a justified emergency (evidence must be provided, employment interviews, employer events, weddings, vacations, etc. are not excused absences.), you must contact the instructor immediately within 24 hours for scheduling a make-up exam. Exam grade disputes must be made to the instructor within one week after grades are posted. Any grade dispute after the specified period will not be considered. The following describes the procedure:

- (1) Within one week after your grade has been posted, e-mail the teaching assistant requesting a grade breakdown,
- (2) Compare your solution to the solution posted on the website using the detailed grade breakdown you receive,
- (3) If you still have questions about your grade, to resolve the issue either meet the instructor during office hours or request an appointment.

### **Grading Policy**

Your performance in the course will be evaluated based on three exams, homework assignments, and in-class assignments/participation. More information on UF grading policy may be found at: <https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>. The table below shows the percentage of each assignment.

Assignment	Percentage of Final Grade
Homework	20%
Exam 1	20%
Exam 2	20%
Exam 3	20%
In-Class Assignment and Participation	20%
Total	100%

### **Grade Scale**

Range	Grade	Grade Points
93.0 - 100.0	A	4.00
90.0 - 92.9	A-	3.67
87.0 - 89.9	B+	3.33
83.0 - 86.9	B	3.00
80.0 - 82.9	B-	2.67
77.0 - 79.9	C+	2.33
73.0 - 76.9	C	2.00
70.0 - 72.9	C-	1.67
67.0 - 69.9	D+	1.33
63.0 - 66.9	D	1.00
60.0 - 62.9	D-	0.67
0 - 59.9	E	0.00

### **Students Requiring Accommodations**

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting <https://disability.ufl.edu/students/get-started/>. It is

important for students to share their accommodation letter with their instructor and discuss their access needs, 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/>.

### ***In-Class Recording***

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A “class lecture” is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

### ***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://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-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.

### ***Commitment to a Safe and Inclusive Learning Environment***

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Program Coordinator

- Robin Bielling, Director of Human Resources, 352-392-0903, [rbielling@eng.ufl.edu](mailto:rbielling@eng.ufl.edu)
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, [taylor@eng.ufl.edu](mailto:taylor@eng.ufl.edu)
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, [nishida@eng.ufl.edu](mailto:nishida@eng.ufl.edu)

### **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: <https://registrar.ufl.edu/ferpa.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 Discrimination, Harassment, Assault, or Violence**

If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the **Office of Title IX Compliance**, located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, [title-ix@ufl.edu](mailto:title-ix@ufl.edu)

##### **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/>.

##### **COVID-19**

- You are expected to wear approved face coverings at all times during class and within buildings even if you are vaccinated.
- If you are sick, stay home and self-quarantine. Please visit the UF Health Screen, Test & Protect website about next steps, retake the questionnaire and schedule your test for no sooner than 24 hours after your symptoms began. Please call your primary care provider if you are ill and need immediate care or the UF Student Health Care Center at 352-392-1161 (or email [covid@shcc.ufl.edu](mailto:covid@shcc.ufl.edu)) to be evaluated for testing and to receive further instructions about returning to campus.
- If you are withheld from campus by the Department of Health through Screen, Test & Protect, you are not permitted to use any on campus facilities. Students attempting to attend campus activities when withheld from campus will be referred to the Dean of Students Office.

- UF Health Screen, Test & Protect offers guidance when you are sick, have been exposed to someone who has tested positive or have tested positive yourself. Visit the [UF Health Screen, Test & Protect website](#) for more information.
- Please continue to follow healthy habits, including best practices like frequent hand washing. Following these practices is our responsibility as Gators.

### 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://care.dso.ufl.edu>.

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