

**Title of Course**

EEL 4610 **State Variable Methods in Linear Systems**

**Class Periods:** MWF period 6, 3:30-4:45PM

**Location:** NEB 102

**Academic Term:** Summer 2022

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**Instructor:**

Dr. Jacob Hammer

Email Address [hammer@mst.ufl.edu](mailto:hammer@mst.ufl.edu)

Office Phone Number 352-392-4934

Office Hours: MWF 5:10-5:50PM on Zoom

**Teaching Assistant/Peer Mentor/Supervised Teaching Student:**

Please contact through the Canvas website

- Kevin Nelson ([kjnelson@ufl.edu](mailto:kjnelson@ufl.edu))

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**Course Description**

Linear algebra and state variable methods for design and analysis of discrete and continuous linear systems.

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

Linear Control Systems EEL 4657

**Course Objectives**

To teach engineering students the use of state variable methods in the design and analysis of linear control systems.

These objectives will be accomplished through instruction in the following topics

- Realization theory and implementation (5 weeks).
- Controllability of linear systems.
- State feedback and stabilization of linear systems
- Linear observers.
- Observability of linear systems.
- Combining observers and controllers.

Stabilizability and detectability of linear systems.

### ***Materials and Supply Fees***

NA

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

This course consists of 1.5 credits of Engineering Design and 1.5 credits of Engineering Science

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

Ta - an ability to apply knowledge of mathematics, science, and engineering

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 multi-disciplinary teams

e - an ability to identify, formulate, and solve engineering problems

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

EE Program Criteria

EE2 - knowledge of mathematics, basic and engineering sciences necessary to analyze and design complex systems

EE3 - knowledge of advanced mathematics including linear algebra, complex variables and discrete mathematics

### ***Required Textbooks and Software***

- Title Linear Systems
- Author T. Kailath
- 1980, First Edition, Prentice-Hall, Inc.
- ISBN number 0135369614

(if course notes derived from various published sources are used, provide information above for each source)

(if course notes are developed by the instructor, so state)

### ***Recommended Materials***

- Title
- Author
- Publication date and edition
- ISBN number

### ***Course Schedule***

Week 1:	Introduction
Week 2:	Background
Week 3:	Realization of Linear Systems
Week 4:	Observability
Week 5:	Reachability
Week 6:	Constructibility
Week 7:	Controllability
Week 8:	Discrete-time systems
Week 9:	Linear State Feedback
Week 10-11:	Asymptotic Observers
Week 12-13:	The Observer-Controller Configuration
Week 14:	Review

### ***Attendance Policy, Class Expectations, and Make-Up Policy***

Regular attendance is recommended, but no attendance will be taken.

Students must coordinate with instructor before missing an exam.

Makeups will be offered for excused absences and missed homework.

Excused absences are consistent with university policies in the undergraduate catalog (<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx> ([Links to an external site.](#))) and require appropriate documentation.

Students must possess portable computers and bring them to class upon announcement.

Excused absences must be consistent with university policies in the undergraduate catalog (<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx> ([Links to an external site.](#))) and require appropriate documentation.

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

<b>Assignment</b>	<b>Total Points</b>	<b>Percentage of Final Grade</b>
Homework Sets	10 each	10%
Midterm Exam	100	35%
Final Exam	100	55%
		100%

### ***Grading Policy***

93 - 100    A    4.00

90 - 92    A-    3.67

87 - 89	B+	3.33
83 - 86	B	3.00
80 - 82	B-	2.67
77 - 79	C+	2.33
73 - 76	C	2.00
70 - 72	C-	1.67
67 - 69	D+	1.33
63 - 66	D	1.00
60 - 62	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> (Links to an external site.)

### ***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/> (Links to an external site.). 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/> (Links to an external site.). 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/> (Links to an external site.). Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/> (Links to an external site.).

## **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 Conduct Code (<https://sccr.dso.ufl.edu/process/student-conduct->

[code/](#) ([Links to an external site.](#)) specifies a number of behaviors that are in violation of this code and the possible sanctions. 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
- Jennifer Nappo, Director of Human Resources, 352-392-0904, [jpennacc@ufl.edu](mailto:jpennacc@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> ([Links to an external site.](#))

### ***Campus Resources:***

*Health and Wellness*

## **Covid-19 Protocols:**

- You are expected to wear approved face coverings at all times during class and within buildings even if you are vaccinated. Please continue to follow healthy habits, including best practices like frequent hand washing. Following these practices is our responsibility as Gators.
- 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. 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 \(Links to an external site.\)](#) for more information.

## **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:** <https://counseling.ufl.edu> (Links to an external site.), 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 \(Links to an external site.\)](#)



[external site.](#)), 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/> ([Links to an external site.](#)).

### *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> ([Links to an external site.](#)).

**Career Resource Center**, Reitz Union, 392-1601. Career assistance and counseling; <https://career.ufl.edu> ([Links to an external site.](#)).

**Library Support**, <http://cms.uflib.ufl.edu/ask> ([Links to an external site.](#)). 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/> ([Links to an external site.](#)).

**Writing Studio, 302 Tigert Hall**, 846-1138. Help brainstorming, formatting, and writing papers. <https://writing.ufl.edu/writing-studio/> ([Links to an external site.](#)).

**Student Complaints Campus**: <https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/> ([Links to an external site.](#)); <https://care.dso.ufl.edu> ([Links to an external site.](#)).

**On-Line Students Complaints**: <http://www.distance.ufl.edu/student-complaint-process> ([Links to an external site.](#)).