

# Course Syllabus

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## **Title of Course**

**EEL 5182, State Variable Methods in Linear Systems**

***Class Periods:*** M W F 7, 1:55-2:45PM

***Location:*** BEN 0328

***Academic Term:*** Fall 2019

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## ***Instructor:***

Dr. Jacob Hammer

hammer@mst.ufl.edu

Office Phone Number 392-4934

Office Hours: MWF 3:50-4:40PM

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

Please contact through the Canvas website

- NA
- NA

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## ***Course Description***

Linear algebra and state variable methods for design and analysis of discrete and continuous linear systems. 3 credit hours

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

EEL 4657

### ***Course Objectives***

- **Specific Outcomes of Instruction:** A course on the use of state variable methods in the design of linear control systems.
- **Brief List of Topics to Be Covered**
- 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***

List if applicable

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

- Title . "Linear systems", Prentice-Hall, NJ,
- Author T. Kailath
- Publication date and edition 1980, First Edition
- ISBN number 978-0135369616

### ***Recommended Materials***

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

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

Attendance is recommended but not required.

Missed homeworks and exams can be made up, if properly justified.

Excused absences must be in compliance with university policies in the Graduate Catalog (<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#attendance> [\\_\(http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#attendance\)\\_](http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#attendance)) 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***

The following is given as an example only.

<b>Percent</b>	<b>Grade</b>	<b>Grade Points</b>
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 - 65.9	D	1.00
60.0 - 62.9	D-	0.67
0 - 59.9	E	0.00

More information on UF grading policy may be found at: <http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#grades>  
(<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#grades>)

### ***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> (<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/> (<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.

## ***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) (<mailto:rbielling@eng.ufl.edu>)
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, [taylor@eng.ufl.edu](mailto: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) (<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> [\\_\(https://registrar.ufl.edu/ferpa.html\)](https://registrar.ufl.edu/ferpa.html)

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

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### ***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 \(mailto:umatter@ufl.edu\)](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> [\\_\(http://www.counseling.ufl.edu/cwc\)](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** (<https://titleix.ufl.edu/>), located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, [title-ix@ufl.edu](mailto: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/> (<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> (<https://lss.at.ufl.edu/help.shtml>)

**Career Resource Center**, Reitz Union, 392-1601. Career assistance and counseling. <https://www.crc.ufl.edu/> (<https://www.crc.ufl.edu/>)

**Library Support**, <http://cms.uflib.ufl.edu/ask> (<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/>  
(<https://teachingcenter.ufl.edu/>).

**Writing Studio**, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers. <https://writing.ufl.edu/writing-studio/>  
(<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)  
([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> [.\(http://www.distance.ufl.edu/student-complaint-process\)](http://www.distance.ufl.edu/student-complaint-process).

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### **Title of Course**

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

**Class Periods:** MWF period 7, 1:55-2:45PM

**Location:** BEN 328

**Academic Term:** Fall 2019

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### **Instructor:**

Dr. Jacob Hammer

Email Address hammer@mst.ufl.edu

Office Phone Number 352-392-4934

Office Hours: MWF 3:50-4:40PM in NEB 563

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

Please contact through the Canvas website

- NA
- NA

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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 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

Weel 7:	Controllability
Week 8:	Discrete-time systems
Week 9:	Linear State Feedback
Week 10-11:	Asymptotic Observers
Week 12-13:	The Observer-Controller Configuration
Weel 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.**)**Links to an external site.**  
(<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>)) and require appropriate documentation.

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

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(<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>)) and require appropriate documentation.

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

<b>Assignment</b>	<b>Total Points</b>	<b>Percentage of Final Grade</b>
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Homework Sets (10)	100 each	10%
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93 - 100	A	4.00
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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

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- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, [taylor@eng.ufl.edu](mailto: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) (<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.



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## ***Campus Resources:***

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### *Health and Wellness*

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**Counseling and Wellness Center:** <http://www.counseling.ufl.edu/cwc> [\\_\(http://www.counseling.ufl.edu/cwc\)\\_](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**

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**Career Resource Center**, Reitz Union, 392-1601. Career assistance and counseling. <https://www.crc.ufl.edu/> (<https://www.crc.ufl.edu/>).

**Library Support**, <http://cms.uflib.ufl.edu/ask> (<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/> (<https://teachingcenter.ufl.edu/>).




**Writing Studio**, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers. <https://writing.ufl.edu/writing-studio/> (<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)  
[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> [.\(http://www.distance.ufl.edu/student-complaint-process\)](http://www.distance.ufl.edu/student-complaint-process)).

## Course Summary:

Date	Details	
Fri Sep 21, 2018	 <a href="https://ufl.instructure.com/courses/369410/assignments/3901912">Homework 1 (https://ufl.instructure.com/courses/369410/assignments/3901912)</a>	due by 11:59pm
Mon Oct 1, 2018	 <a href="https://ufl.instructure.com/courses/369410/assignments/3901913">Homework 2 (https://ufl.instructure.com/courses/369410/assignments/3901913)</a>	due by 11:59pm
Mon Oct 22, 2018	 <a href="https://ufl.instructure.com/courses/369410/assignments/3901914">Homework 3 (https://ufl.instructure.com/courses/369410/assignments/3901914)</a>	due by 11:59pm
Tue Nov 6, 2018	 <a href="https://ufl.instructure.com/courses/369410/assignments/3901909">midterm exam (https://ufl.instructure.com/courses/369410/assignments/3901909)</a>	due by 7pm
Wed Nov 14, 2018	 <a href="https://ufl.instructure.com/courses/369410/assignments/3901915">Homework 4 (https://ufl.instructure.com/courses/369410/assignments/3901915)</a>	due by 11:59pm
Fri Nov 23, 2018	 <a href="https://ufl.instructure.com/courses/369410/assignments/3901911">Homeowrk 5 (https://ufl.instructure.com/courses/369410/assignments/3901911)</a>	due by 11:59pm
Mon Dec 3, 2018	 <a href="https://ufl.instructure.com/courses/369410/assignments/3901916">homework 6 (https://ufl.instructure.com/courses/369410/assignments/3901916)</a>	due by 11:59pm
Fri Dec 7, 2018	 <a href="https://ufl.instructure.com/courses/369410/assignments/3901917">Homework 7 (https://ufl.instructure.com/courses/369410/assignments/3901917)</a>	due by 5pm

Date	Details
Wed Dec 12, 2018	 <a href="https://ufl.instructure.com/courses/369410/assignments/3901908">Final Exam (https://ufl.instructure.com/courses/369410/assignments/3901908)</a> due by 6pm
	 <a href="https://ufl.instructure.com/courses/369410/assignments/3901910">Final Grade (https://ufl.instructure.com/courses/369410/assignments/3901910)</a>
	 <a href="https://ufl.instructure.com/courses/369410/assignments/3901918">sample (https://ufl.instructure.com/courses/369410/assignments/3901918)</a>