ECE 5551: State-Space Control Systems

Course Description

Discrete-time state variable representations; pole placement via state-feedback; introduction to realization theory; observer design; introduction to Kalman filtering; linear quadratic regulator theory.

Prior Course Number: 650, 750 and 755
Transcript Abbreviation: SV Control
Grading Plan: Letter Grade
Course Deliveries: Classroom
Course Levels: Undergrad, Graduate
Student Ranks: Senior, Masters, Doctoral
Course Offerings: Autumn
Flex Scheduled Course: Never
Course Frequency: Every Year
Course Length: 14 Week
Credits: 3.0
Repeatable: No
Time Distribution: 3.0 hr Lec
Expected out-of-class hours per week: 6.0
Graded Component: Lecture
Credit by Examination: No
Admission Condition: No
Off Campus: Never
Campus Locations: Columbus
Prerequisites and Co-requisites: Prereq: 3050 (352), and Stat 3470 (427) or Math 530; or grad standing.
Exclusions: Not open to students with credit for 650, 750, or 755.
Cross-Listings:

Course Rationale: Existing course.

The course is required for this unit's degrees, majors, and/or minors: No
The course is a GEC: No
The course is an elective (for this or other units) or is a service course for other units: Yes

Subject/CIP Code: 14.1001
Subsidy Level: Doctoral Course

Programs

Abbreviation	Description
CpE	Computer Engineering
EE	Electrical Engineering

Course Goals

Learn feedback control systems design by pole placement (state feedback) and state observers
Introduce students to advanced topics of realization theory, Kalman filtering, and Linear Quadratic Regulator (optimal control)
Develop tools for analysis and design of discrete-time control systems, from a state-variable viewpoint
Exposure to computer-aided analysis and design (using Matlab)and simulation

Introduce useful engineering concepts from theory of discrete equivalents, sampling and reconstruction, Z-domain design

Course Topics

Topic	Lec	Rec	Lab	Cli	IS	Sem	FE	Wor
State variable models	2.0							
Continuous state variable models, sample and hold, system delays in state variable representations	3.0							
State variable representation in discrete time, solution of state variable difference equations	5.0							
Design using discrete equivalents, numerical integration methods	4.0							
State space models, stability, and control design (controllability and pole placement)	8.0							
Estimator design and observability	5.0							
Separation principle, inclusion of reference input and integral control	4.0							
Introduce students to advanced topics of realization theory, Kalman filtering, and Linear Quadratic Regulator (optimal control)	6.0							

Representative Assignments

homework problems are assigned from the textbook, and composed by the instructor

Grades

Aspect	Percent
Homework	30%
Midterm Exams (2)	30%
Final Exam	40%

Representative Textbooks and Other Course Materials

Title	Author
Digital Control of Dynamic Systems, 3rd Ed., (required)	Franklin, Powell and Workman

ABET-EAC Criterion 3 Outcomes

Course Contribution		College Outcome
***	a	An ability to apply knowledge of mathematics, science, and engineering.
	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.
	d	An ability to function on multi-disciplinary 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.

Course Contribution		College Outcome
	h	The broad education necessary to understand the impact of engineering solutions in a global 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.

Additional Notes or Comments

Changed course description, prereqs, exclusions, goalds and topics to match university standard form

Deleted texts Discrete-Time Control Systems, K. Ogata
and
Fundamentals of Linear State Space Systems. J.S. Bay, March 29. 2012

add grad standing to prereqs

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