

Class Meeting Location STD CENTER B335
Class Meeting Times MN B4,WE B4

Instructor ALPER ERDOĞAN
Office Hours Wednesday 16:00-17:00
Office Location ENG 221
Office Phone
Email alperdogan@ku.edu.tr
Web Address http://aspc.ku.edu.tr

Number of Credits 3
ECTS Credits 6
Prerequisites
Language English

Assistant

TARA/Lab Assistant Name	Email	Office Hours	Office Location
MURAT KUŞCU	mkuscu@ku.edu.tr		

Course Description

Linear Algebra Review, Normal Matrices, Quadratic Forms and Semidefinite Matrices, Inner Product and Norm Spaces, State Space Descriptions for Continuous and Discrete Time Systems, Controllability, Observability, Stability, Realization Theory.

Course Objectives

The course aims to provide linear system theory background to students for taking advanced classes or performing research in signal processing, communications, control and other engineering disciplines.

Learning Outcomes

Major outcomes of this course can be listed as follows

- 1) Comprehend basic linear algebra and vector space concepts.
- 2) Understand basic matrix factorizations such as QR, LDU, EVD, Schur, SVD and their applications in linear systems
- 3) Understand special matrices with emphasis on (semi)definite matrices and their use in quadratic forms.
- 4) Understand inner product and norm space concepts and their use in various linear system related applications, with emphasis on projection theorem.
- 5) Least Squares method and its applications in linear systems.
- 5) Learn State-Space Description of both continuous time and discrete time systems.
- 6) Understand the derivation of time response as a function of state space parameters.
- 7) Comprehend the concepts of controllability, observability and minimal realization.
- 8) Understand the stability concept in connection with the state space models.

Teaching Methods

The course duration is 14 weeks, and each week will contain two 75-minute lectures. The students will be regularly assigned homework exercises. There will be one midterm and one final exam.

Course Contents

Session Number	Starting Date	Topics
1	16/09/2013	Introduction and Motivation
1	18/09/2013	Linear Algebra Review: Vector Space and Subspace
1	23/09/2013	Linear Algebra Review: Linear Combination, Span, Linear Independence, Basis, Euclidian Norm in R^n
1	25/09/2013	Linear Algebra Review: Euclidian Inner Product in R^n , Matrix-Vector Product, Range Space of a Matrix

1	30/09/2013	Linear Algebra Review: Null Space, Direct Sum of Subspaces, Four Fundamental Spaces
1	02/10/2013	Linear Algebra Review: Rank, Analysis of $Ax=b$ based on Fundamental Spaces, On Solutions of $Ax=b$
1	07/10/2013	Linear Algebra Review: Basis Change, Eigenvalue Decomposition and Diagonalization, Schur Decomposition and Triangularization
1	09/10/2013	Complex Inner Product, Orthogonal and Orthonormal Sets, Orthogonal Projection, Projection Matrices, Unitary and Orthogonal Matrices,
1	21/10/2013	QR Factorization: Gram-Schmidt Orthogonalization, Householder Triangularization
1	23/10/2013	Normal Matrices, Hermitian Matrices, Positive (Negative) (semi)definite Matrices
1	30/10/2013	Quadratic Forms
1	04/11/2013	Properties of (semi) definite matrices, matrix square root, Cholesky Decomposition with Applications
1	06/11/2013	Norm Spaces, Vector Norms, Matrix Norms: Frobenius Norm, Induced Norms, Schatten-p norms
1	11/11/2013	Inner Product Spaces, Projection Theorem, Linear Least Squares
1	13/11/2013	Least Norm Solution and Applications
1	18/11/2013	Singular Value Decomposition, Polar Decomposition with Applications
1	20/11/2013	State Space Description of Dynamical Systems
1	25/11/2013	Time Domain Solution of State Space Equations
1	27/11/2013	Frequency Domain Methods
1	02/12/2013	Linear Dynamical System Examples
1	04/12/2013	Canonical State Space Realizations
1	09/12/2013	Controllability
1	11/12/2013	Observability
1	16/12/2013	Stability
1	18/12/2013	Linear Quadratic Regulator
1	23/12/2013	Lyapunov Theory
1	25/12/2013	Lossless Systems

Assessment Methods

Type	Description	Final Grade, %
Homework	Homework	20
Midterm Test	Midterm Exam	35
Final Exam	Final Exam	45
Total		100

Workload Breakdown

Type	Description	Hours
Lecture	Regular Lectures	34
Assignment	Homework Solution Preparation	40
Exam	Midterm Preparation and Midterm Exam	18
Exam	Final Exam Preparation and Final Exam	20
Other	Pre-lecture Preparation	29
Other	Lecture Review	40
Total		181

Sources

Recommended Readings

- Mathematical Methods and Algorithms for Signal Processing by Todd K. Moon and Wynn C. Stirling.
- Matrix Analysis by Horn and Johnson
- Linear Systems by Thomas Kailath
- Linear System Theory and Design by Chi-Tsong Chen
- Linear Algebra and its Applications by Gilbert Strang

Other

N/A

Academic Dishonesty

N/A