

EEE 241 LINEAR SYSTEMS ANALYSIS

Required Graduate Course

Date: 2/24/2007

Course Area: Graduate Core area course covering Linear Algebra and System Analysis

Course Coordinator: Mahlon D. Heller, Ph.D.

Catalog Description: Analyzes linear systems in the state-space. System realization and modeling, solutions of linear systems, stability including the method of Lyapunov, controllability and observability, state feedback and observers for both continuous and discrete-time systems. Familiarity with MATLAB is required. 3 units.

Prerequisites: EEE180, Signals and Systems, or equivalent and some familiarity with MATLAB

Text: Chi-Tsong Chen, *LINEAR SYSTEM THEORY AND DESIGN*, 3rd EDITION, Oxford, 1999.

Additional Resources: Student Version of MATLAB (Version 5.0 or later) or access to MATLAB. MATLAB is on the computers in the Campus Open Computer Labs.

Course Objectives:

- 1) Acquaint or reacquaint you with state variable representations of linear systems.
- 2) Introduce you to underlying linear algebra concepts.
- 3) Introduce you to linear system analysis:
 - State-Space Solutions
 - Stability
 - Controllability and Observability.
 - Minimal realizations
- 4) Introduce you to the design stable linear systems using state feedback and state estimators.

Expected Major Outcomes:

- 1) The student is expected to be able to analyze continuous and discrete-time systems by applying the analysis techniques learned.
- 2) The student is expected to be able to create a minimal linear system given a linear state-space system.
- 3) The student is expected to be able to design a state-estimator for the observable states given a stable or unstable linear state-space system.
- 4) The student is expected to be able to design a feedback controller, to stabilize the system using pole-placement techniques given a stable or unstable linear state-space system.

Some class periods will be conducted in the RVR 5017 laboratory where MATLAB will be used in support of the above objectives.

Prerequisites by Topic:

Perquisite	Topic
Matrix Algebra	Linear Algebra
Laplace Transforms	Mathematical Descriptions of Systems
Circuit Analysis ...	State-Space Realizations

Topics Covered: Mathematical descriptions of systems, linear algebra, state-space solutions and realizations, stability analysis of linear systems, controllability and observability of state-variables, minimal state realizations, and state feedback and state estimators.

Evaluation: Homework and Lab Assignments (20%), midterm exam (40%) and final exam (40%).

Course Outline/Schedule

<i>Week</i>	<i>Topic</i>	<i>Text Reference</i>
1	INTRODUCTION	Chapter 1
2	MATHEMATICAL DESCRIPTIONS OF SYSTEMS	Chapter 2
3	LINEAR ALGEBRA	Chapter 3
5	STATE-SPACE SOLUTIONS AND REALIZATIONS	Chapter 4
8	MID-TERM EXAM OVER CHAPTERS 1 THROUGH 4	
9	STABILITY	Chapter 5
11	CONTROLLABILITY AND OBSERVABILITY	Chapter 6
13	MINIMAL REALIZATIONS AND COPRIME FRACTIONS	Chapter 7
14	STATE FEEDBACK AND STATE ESTIMATORS	Chapter 8
16	FINAL EXAM OVER CHAPTERS 5 THROUGH 8	