# 332:501 System Analysis – Fall 2024

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**Course Description**:

This course introduces the fundamentals of linear system concepts via solution of linear differential and difference equations. The curriculum covers the state space approach for multi-input multi-output (MIMO) linear systems, and introductions to the concepts of linear system stability, controllability, observability, and minimal realization.

- Exposing the student to analytic tools used in signal processing, communications, and controls (Fourier and Laplace transforms, frequency domain description of linear systems, etc.,)

- Aiding students in extending the concepts learned in circuit analysis to more abstract linear mapping relationships, and fostering an appreciation for the broad applicability of system theory across various fields of engineering and science

**Textbook**: F. Szidarovsky and A. T. Bahill, "Linear Systems Theory", CRC Press,1997

**Class website**: https://canvas.rutgers.edu

**Office Hours**: Friday 2~5pm or by appointment

(Note: Office hours are subject to change if multiple students request it.)

| CHAPTER | TOPICS | WEEK |
|---|---|---|
| | Introduction | 1 |
| **Chapter 1:** | Mathematical Background | 1, 2 |
| **Chapter 2:** | Sections 2.1.2 and 2.1.3: Solution of Differential Equations | 2 |
| | Section 2.2: Solution of Difference Equation | 3 |
| **Chapter 3:** | Sections 3.3 and 3.4: The State Space Approach | 4 |
| | Section 3.5: Applications | 5 |
| **Chapter 4:** | Stability Analysis | 5 & 6 |
| **Chapter 5:** | Linear System Controllability | 6 & 7 |
| **Chapter 6:** | Linear System Observability | 8 & 9 |
| **Chapter 7:** | Canonical Forms with Applications | 10 & 11 |
| **Chapter 9:** | Estimator (Observer) Design | 11 & 12 |
| **Chapter 10:** | Section 10.1: Non-negative Systems | 13 |
| | Section 10.2: An Introduction to the Kalman Filter | 13 |
| **Chapter 3:** | Sections 3.1 and 3.2: Linearization of Nonlinear Systems | 14 |
| **Chapter 8:** | Section 8.1.2 Minimal System Realization and | |
| **My Notes** | System Order Reduction | 14, 15 |

**Grading:**     Collected Homework     20%
Midterm                30%
Final Exam             30%
Project                 20%

**Homework:**  Homework will be assigned regularly, typically once per week or so. Assignments will be due one week after they are assigned and must be submitted to the course Canvas website as PDF files.

Note: This syllabus is tentative and subject to change.