ECGR6111/8111 Linear System Theory

Course Lecturer

Jonathan Bird
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Office Hours: Wednesday 1-3pm

Lecture Room: EPIC 2224
Lecture Time: Tuesday and Thursday, 3:30-4:45pm
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Course Textbook

Chi-Tsong Chen, *Linear System Theory and Design*, 3rd or 4th Edition, Oxford University Press.

Reference Textbooks

- Hespanha, Joao P., *Linear Systems Theory*, Princeton University Press - annotated edition, August, 2009
- D'Azzo, John J., Houpis, Constantine H., Linear Control System Analysis and Design, Conventional and Modern, 4th ed., McGraw-Hill, New York, 1995.
- Bay, John, Fundamentals of Linear State Space Systems, WCB/McGraw Hill, New York, 1999.
- DeRusso, Paul M., Roy, R. J., Close, C. M., Desrochers, A. A., State Variables for Engineers, 2nd ed., John Wiley & Sons, Inc, New York, 1998.

Grading

The final grade will be determined as follows:

Homework	40%
Mid term test	25%
Final exam	35%

Academic Dishonesty

All UNC Charlotte students have the responsibility to know, observe and enforce the requirements of *The UNC Charlotte Code of Student Academic Integrity* (*http://legal.uncc.edu/policies/up-407*). This Code forbids cheating, fabrication or falsification of information, multiple submissions of academic work, plagiarism, abuse of academic materials, and complicity in academic dishonesty. Also see http://integrity.uncc.edu .

Disability Services

It is University policy, on a flexible and individualized basis, to grant reasonable accommodations to students with disabilities that may affect their ability to participate in course activities or to meet course requirements. Students with disabilities are encouraged to contact their course instructor early in the semester to discuss their individual needs for accommodations. Please also provide a letter of accommodations from UNC Charlotte Disability Services (http://www.ds.uncc.edu).

Lecture Topic Plan

1. Models of linear systems - Linear Systems and State Equations, Linearization of Nonlinear Equations

2. Vector and Vector Spaces - Vectors, Vector Spaces, Gram-Schmidt Procedure, Subspaces and Vector Projection Theorem, Linear Algebra.

3. Linear Operation of Vector Spaces – Definition of Linear Operator, Operator as Spaces, Simultaneous Linear equations

4. Eigenvalues and Eigenvectors – A-Invariant Subspace, Definition of Eigenvalues and Eigenvectors, Finding Eigenvalues and Eigenvectors, The basis of Eigenvectors, Singular Values

5. Functions of Vectors and Matrices – Linear Functionals, Multi Linear Functionals, Quadratic Forms, Function Of matrices

6. Solution to State Equations – Linear Time Invariant (LTI) systems, Homogeneous Systems, System models and decompositions, The Time Invariant Case, Solving Discrete Time Systems

7. System Stability - Lyapunov Stability, Lyapunov's Direct method, External Stability, Relationship Between the Stability Types

8. Controllability and Observability - Definitions, Controllability Tests for LSI systems, Model Controllability and Observability, Controllability and Observability of Time Invariant Systems, Discrete Time systems, Controllability and Observability under Sampling.

9. System Realizations - Minimal Realization, Specific Realization, Markow Parameters, Balanced Realization, Discrete Time System Identification

10. State Feedback and Observers - State feedback for SISO Systems, Multivariable Canonical Forms, Observers