EE 650 **Fall 2014**

Linear Systems Theory

MW, 12:00pm–1:15pm, Holmes 388

Why study linear systems ?

- Many physical systems can be accurately modelled as a linear system around an operating point.
- Well-developed theoretical and computational tools are available for linear systems.
- Linear systems theory forms the basis for many advanced topics such as nonlinear systems, optimal control, robust control...
- As our computational power is increasing, applications are increasingly arising in many diverse fields. Examples: feedback controller design; estimator/predictor design; control of communication networks (flow control, admission control); circuit analysis, simulation, design; economics, finance; aeronautics applications, navigation, guidance; civil and chemical engineering applications.

Class Information

This is a fundamental graduate-level course on the modern theory of dynamical systems and control. It builds on an introductory undergraduate course in control, and emphasizes state space techniques for the analysis of dynamical systems and the synthesis of control laws meeting given design specifications. To follow the course, some familiarity with linear algebra would be helpful, although the necessary material will be reviewed during the course.

Instructor:	Gürdal Arslan, Holmes 440, Phone: 956–3432, E-mail: `gurdal@hawaii.edu`
Office Hours:	Open
Text:	Linear System Theory and Design by C-T. Chen, 3rd Ed.
Webpage:	`www2.hawaii.edu/~gurdal/EE650.htm`, Site of announcements, handouts, homeworks, etc.
Grading:	Homework 10%; Mid-term I 25%; Mid-term II 25%; Final Exam 40%.
Important Dates:	Mid-term I (Tentative): Monday, October 6, 2014, in class. Mid-term II (Tentative): Monday, November 10, 2014, in class. Final Exam: TBD (December 15 or 17, 2014, 12:00pm-2:00pm), in class.
Policies:	No credit will be given to late homeworks. Exams must be taken at the announced times.

Topics

- Mathematical Descriptions of Systems
- Linear Algebra Review
- Linear Dynamical Equations
- Stability
- Controllability and Observability
- Minimal Realizations
- Feedback Control Design
- Introduction to Optimal Feedback Control (as time permits)

Course SLOs and Their Relationship to Program Outcomes

- Ability to develop multi-input multi-output state-space models for physical systems [1]
- Ability to linearize a nonlinear state-space model [1]
- Knowledge of relevant linear algebra concepts and techniques for the analysis of state-space models [1]
- Ability to obtain the solutions of the autonomous state-space models as well as the solutions with an external input [1]
- Understanding of stability, controllability, observability, and Kalman-decompositions [1]
- Understanding of the relationship between state-space and transfer function models as well as irreducible realizations [1]
- Ability to design state-feedback controllers including pole-placement [1]
- Ability to design state estimators and dynamic output-feedback controllers [1]
- Ability to design static output-feedback controllers and understanding its limitations [1]
- Ability to use modern computational tools such as MATLAB for analyzing, designing, simulating and testing state-space based control systems [1].