332:416 Control System Design — Spring 2004

Prerequisites: 332:415 Introduction to Automatic Control or 650:401 Mechanical Control Systems

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Class Home Page: http://www.ece.rutgers.edu/˜gajic/416.html

Teaching Assistant:

Text: Z. Gajic and M. Lelic, *Modern Control Systems Engineering* , Prentice Hall, 1996. (GL96) and Class Notes (CN00)

Recommended Reading: B. Friedland, *Advanced Control System Design*, Prentice Hall, 1995. (F95)

Topics:

Lectures 1: Review of control system design specifications (GL96—Chapters 6, Section 4.6)

Lectures 2–3: Classical controller design based on the root locus technique (GL96—Chapters 7 and 8)

Lectures 4–5: Classical controller design based on Bode diagrams (GL96—Chapter 9)

Lecture 6: System controllability and observability (GL96—Chapter 5)

Lecture 7: System state feedback pole placement technique (GL96—Section 8.2)

Lectures 8–9: Full-order observer design. Reduced-order observer design (GL96 —Section 5.6)

Lecture 10: Linear-quadratic optimal deterministic regulator problem (GL96—Section 10.3, CN00)

Lectures 11–12: Kalman filter and optimal stochastic regulator (GL96—Sections 10.2, 10.3.2, 10.3.3, CN00)

Lecture 13: Discrete-time linear-quadratic optimal regulator (CN00, F95—Chapter 9)

Lecture 14: Discrete-time observer and Kalman filter (CN00, F95—Chapter 9)

Lecture 15: Exam I

Lecture 16: System identification (GL96—Section 10.5.1)

Lectures 17–18: SIMULINK fundamentals (handout)

Lectures 19–20: Quantitative behavior of nonlinear systems. Stability by the first and second methods of Lyapunov (CN00, F95—Chapter 2; GL96—Section 4.3)

Lecture 21: Linearization of nonlinear systems (GL96—Section 1.6)

Lectures 22–23: Controlling nonlinear systems: extended separation principle; linearization about a set point; extended linearization; feedback linearization (F95—Chapter 4)

Lecture 24: Describing function method (F95—Chapter 3, CN00)

Lecture 25: Observers for nonlinear systems (F95—Chapter 6)

Lecture 26: Reduced-order observers for nonlinear systems (F95—Chapter 6)

Lecture 27: Extended Kalman filter (F95—Chapter 6; CN00)

Lecture 28: Relay tuning of universal (industrial) PID controllers (CN00)

Grading

MATLAB Design Projects 40%

Exam I 30% (Presentation of design algorithms and main control design concepts)

Final Exam 30% (Presentation of design algorithms and main control design concepts)