Louisiana Tech University
Department of Electrical Engineering

ELEN 471 – Automatic Control Systems

Course Information — Fall 2015

Description:	Analysis and design of linear feedback systems. Mathematical modeling. Transfer functions and signal-flow graphs. State variable analysis. Time domain analysis and design of linear control systems. Frequency domain analysis and design of linear control systems.

Instructor: Dr. Rastko R. Selmic, Email: rselmic@latech.edu,
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This term we will be using Piazza for class discussion. The system is highly catered to getting you help fast and efficiently from classmates, the TA, and myself. Rather than emailing questions, I encourage you to post your questions on Piazza.

Find our class page at: https://piazza.com/latech/fall2015/elen471/home

Class Hours: MWF, 11:00am–12:15pm, NETH 120

Office Hours: MTWRF 9:00am–11:00am

Prerequisites: ELEN 321, MATH 244, or consent of instructor.

Textbook: R.C. Dorf and R.H. Bishop, *Modern Control Systems*, 12th ed., Pearson Prentice Hall, Upper Saddle River, NJ, 2011.

Recommended Software: MATLAB Student Version + Control Systems Toolbox

Grading: There will be homework, two exams and the final exam. If you have a question on grading of an assignment or an exam, please contact instructor about your question within one week of the time the grade is received. The weighting of grades is:

- Homework -- 20% (Graduate students: 10% homework + 10% project)
- Exam I -- 25% (1 sheet one side), Monday, October 5
- Exam II -- 25% (1 sheet one side), Monday, November 2
- Final Exam -- 30% (1 sheet one side), Monday, November 16

Scale used: A = 100-90%, B = 89-80%, C = 79-70%, D = 69-60%, F = below 60%.

Students must keep a **notebook** of all their graded assignments and turn it in at the end of the quarter, otherwise receive incomplete grade “I”.

Tests: All tests will be closed book and closed notes. You will be allowed to bring one sheet of notes (8.5” x 11”) one side and a calculator. No make up exams unless approval is obtained prior to the scheduled test date.

Homework: Weekly homework will be assigned. Homework will be graded. No late homework will be accepted. Some homework may require computer simulation using MATLAB.

Other Policy:

a. Class attendance is governed by the university regulations published each year in the university bulletin (page 26).
b. In the event of the appeal, student is responsible for keeping all original graded materials (exams, homework, and projects).
c. Students with disabilities needing testing or classroom accommodations based on a disability are encouraged to discuss those needs with instructor as soon as possible. Please check www.latech.edu/ods for assistance.
d. In accordance with the Academic Honor Code, students pledge the following: “Being a student of higher standards, I pledge to embody the principles of academic integrity.”
e. Emergency Notification System (ENS): All Louisiana Tech students are strongly encouraged to enroll and update their contact information in the Emergency Notification System. It takes just a few seconds to ensure you’re able to receive important text and voice alerts in the event of a campus emergency. For more information on the Emergency Notification System, please visit http://ert.latech.edu

Graduate Students: Graduate students will need to do a research and propose a project until Friday, October 9. Project report is due Friday, November 13. Biweekly reports are required showing the progress of the project.

Course Topics:

1. Linear Systems and Linear Approximations to Nonlinear Systems:
   a. Linear Approximation of Nonlinear Systems
   b. Laplace Transform and Inverse Laplace Transform
   c. Simulation of Dynamic Systems Using MATLAB
2. Block Diagrams and Signal-Flow Graphs
   a. Mason’s Formula
3. Performance of Second Order Systems
4. State variable analysis
   a. Transfer Function From the State Equation
   b. Time Response of Dynamical Systems
5. Stability of Linear Systems
   a. Input/Output Stability
   b. Routh-Hurwitz Stability Test
   c. Stability of State-Variable Systems
6. Feedback Control Systems
   a. Closed-Loop Control Systems

    b. Sensitivity of Control Systems
    c. Disturbance Rejection
    d. Steady-State Error
7. Root Locus Analysis and Design of Feedback Systems
    a. Root Locus Concept
    b. Root Locus Examples
    c. PID, Lead, Lag Controllers
8. PID Controllers and Ziegler-Nichols Tuning
9. State-Variable Feedback
    a. Pole Placement and Ackermann's Formula
10. Frequency Domain Analysis and Design of Feedback Systems
    a. Bode Design
    b. Nyquist Criterion
11. Advanced Feedback Design Techniques
    a. Linear Quadratic Regulator

Bellman's Principle of Optimality: An optimal policy has the property that whatever the initial state and the initial decisions are, the remaining decisions must constitute an optimal policy with regard to the state resulting from the first decision.

"If you don't do the best with what you have happened to have got, you will never do the best with what you should have had."