EE 540 – Dynamic Systems Analysis-3 Hours
Elective course

1. *2007-2008 Catalog description*
Advanced techniques for analysis of electrical, mechanical and electromechanical systems. State function concepts are emphasized with applications for determining state equations, system stability, and control. Prerequisite: EE 302 or graduate standing.

2. *Prerequisites by topics*
a. Signals, systems, physics, linear algebra and matrix theory.
b. Ordinary differential equation theory.

3. *Textbook (s) and/or other required material*
Required: Linear System Theory and Design, third edition, by Chi-Tsong Chen, Oxford University Press, 1999

4. *Class Schedule:* Three sessions per week, each 50 minutes, for 14 weeks

5. *Topics Covered (Outcomes influenced)*
- Mathematical modeling of systems and derivation of differential equations for physical systems using using laws of physics and Lagrangians (7a)
- Linear algebra, matrix theory (7b)

Solution of state-space equations, fundamental matrix and state transition matrix (7b)
- Matlab and Simulink computer software for analysis, design and simulation of control systems (7c)
- Stability of dynamic systems and Lyapunov stability criteria (7d)
- Controllability, observability and Kalman canonical form decomposition (7e)
- Realization of state-space equation from matrix transfer function (7f)
- State variable feedback control and state estimators (7g)
- Robust tracking and model matching (7h)
- Linear quadratic regulator control (7i)
- Grading Policy and ECE Code of Conduct (7j)

6. *Contribution of course to meeting the professional components*
Engineering science - 75%, Engineering Design - 25%

7. *Course Outcomes (Program Outcome contributions): In learning the course topics, the student will attain the following outcomes*
a. The student will use laws of physics and Lagrangians to derive differential equations for dynamic systems (9A, 9B)
b. The student will solve linear state-space matrix differential equations and determine the fundamental matrix and the state transition matrix (9A, 9B)
c. The student will use Matlab and Simulink software tools to analyze, design and simulate control systems (9A, 9B, 9C, 9D)
d. The student will determine the stability of linear and nonlinear dynamic systems (9A, 9B)
e. The student will determine controllability, observability and Kalman decomposition of dynamic systems (9A, 9B)
f. The student will extract minimal state-space realization equations from matrix transfer functions (9A, 9B)
g. The student will design state feedback controllers and state estimators (9A, 9B, 9C)
h. The student will design robust tracking and model matching controllers (9A, 9B, 9C)
i. The student will design linear quadratic regulator controllers (9A, 9B, 9C)
j. The student will understand the ECE Code of Conduct (9G)

8. Grading policy and criteria

Homework: Solving homework problems will make you proficient. Homework problems will be assigned, but not collected or graded. Homework problems solutions will be posted on Blackboard for you to check your solutions.

There will be examination number 1, examination number 2, a comprehensive final examination and pass/fail paper on a contemporary issue in control. An estimate of the letter grade for each of the two examinations will be given when the examination is returned; however, weightings of 30% for examination number 1, 30% for examination number 2 and 40% for the comprehensive final examination will be used to determine the final grade. Examination number 1 will be closed book, closed course notes, one 8.5 by 11 inches page of notes and use of Matlab are allowed. Examination number 2 will be closed book, closed course notes, two 8.5 by 11 inches pages of notes and use of Matlab are allowed. The final examination will be closed book, closed course notes, three 8.5 by 11 inches pages of notes and use of Matlab are allowed. No cell phones and use of internet will be permitted during the examinations. A grade of C corresponds to meeting the minimum competency required to understand course topics and meet course objectives.
Warning: An unexcused absence from a scheduled exam will earn you a zero for that exam. In addition, cheating will be dealt with as described in the *Academic Handbook.* The ECE Faculty has established the ECE Student Code of Conduct based on well known requirements of academic integrity as well as the ethical and professional conduct expected of an engineer. The ECE student code is posted on Blackboard.

9. *Relationship of course to program outcomes*

label	Program Outcomes (A Graduate from the program will:)	Contribution
A	have knowledge of the mathematical and scientific foundation of electrical engineering	Strong
B	have knowledge of and the ability to apply techniques and technology of electrical engineering	Strong
C	complete a design project sequence, culminating in a capstone project at or near the professional level	Moderate
D	understand that acquisition of new knowledge is needed for success in the electrical engineering profession	Moderate
E	meet Bradley's general education requirements which are based on the principles of liberal education	NA
F	have experience in communicating technical information and working on teams	Weak
G	understand the importance of professional and ethical behavior	Moderate

10. *Prepared by*: Winfred N. Anakwa, May 21, 2008