Department of Mechanical Engineering

ME455– Introduction to Automatic Controls

Elective

Catalog Description: **ME 455 (3-0-3)**

Introduction to modern control methods applied to mechanical, manufacturing, and mechatronic systems

Prerequisites: ME 305 – System Dynamics

Textbook(s) Materials Required:

1. **Richard C. Dorf and Robert H Bishop**, Modern Control Systems, 10th Ed., Prentice-Hall, 2005.
2. Software: MATLAB with Control Toolbox.

Course Supervisor: Dr. Z. Ji

Pre-requisite by topic

1. Calculus, Laplace Transform
2. Ordinary differential equations
3. Motion of rigid bodies and kinematics of mechanisms
4. Dynamics

Course Objectives[1]:

1. To develop the student's skills in applying Laplace transform to obtain transfer functions. (A, B, C)
2. To develop student's skills associated with modeling dynamic systems through block diagrams and signal flow graphs. (A, B, C)
3. To develop student with knowledge of state variable models of feedback control systems.(A, B, C)
4. To provide the student with skills in analyzing characteristics of dynamics systems and measures of performances. (A, B, C)
5. To provide the student with analysis skills associated with the assessment of system stability. (A, B, C)
6. To provide the student with the ability to perform root locus analysis. (A, B, C)
7. To provide the student with skills associated with using computer software (MATLAB) in analyzing dynamics systems and control systems. (A, B, C)

Topics[2] :

1. Introduction; MATLAB Basics
2. Block Diagram, Signal Flow Graph and Transfer Function
3. State Variable Models
4. Control System Characteristics
5. Measures of Performance
6. Stability: Routh–Hurwitz method
7. Root Locus Method
8. Frequency Response: Bode Diagrams

9. Stability: Nyquist Criterion

Evaluation Method:
1. Exam
2. Homework

Schedule: Lecture Recitation: 3 hours, per week

Professional Component: Engineering Science

Program Objectives Addressed: A, B, C

Course Outcomes[3]:
Objective 1
1.1 Students will demonstrate an ability to obtain transfer function through block diagrams and signal flow graphs. (1,2) (a,e,k,m,n)
Objective 2
2.1. Students will demonstrate an ability to apply Laplace transforms to obtain transfer functions and solve linear differential equations. (1,2) (a,e,k,m,n)
Objective 3
3.1. Students will demonstrate an ability to obtain state space models of feedback control systems. (1,2) (a,e,h,k)
Objective 4
4.1. Students will demonstrate an ability to perform Root Locus analysis and apply it to study the effect of control parameter(s). (1,2) (a,c,e,k)
Objective 5
5.1 Students will demonstrate an ability to assess system stability using Routh–Hurwitz method and Nyquist Criterion. (1,2) (a,k,n)
Objective 6
6.1 Students will demonstrate an ability to apply computer software to analyze feedback control systems. (1,2) (a,k,n)

Prepared by: Z. Ji **Date: September 28, 2006**

---

[1] Capital Letters in parenthesis refer to the Program Objectives of the Mechanical Engineering
Department. Listed in Sec 2d Tables B-2-9, B-2-12. Table B-2-8 links Program Objectives with the ABET a-k Criterion.
[2] Topic numbers in parenthesis refer to lecture hours. (Three hours is equivalent to 1 week)
[3] Outcome numbers in parenthesis refer to evaluation methods used to assess the student performance. Lower case letters in parenthesis refer to ABET a-k outcomes.