Department of Mechanical Engineering

ME305– Introduction to System Dynamics

(Required)

Catalog Description: **ME 305 (3-0-3)**

Principles of dynamic system modeling and response with emphasis on mechanical, electrical, and fluid systems. Application of computer simulation techniques.

Prerequisites: Mech 236 – Dynamics
ME 231 – Kinematics
Math 222 – Differential Equations

Textbook(s) Materials Required:

1. K. Ogata, System Dynamics, 4th Ed., Prentice-Hall, 2004.
2. Software: MATLAB.

Course Supervisor: Dr. Z. Ji

Pre-requisite by topic:

1. Calculus
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 proper modeling of mechanics to model mechanical, electrical and electromechanical systems. (A, B, C)
2. To develop student's skills in analyzing dynamic systems through the application of the Laplace transforms, block diagrams, and transfer functions. (A, B, C)
3. To develop student's skills in analyzing dynamic systems through the application of transient response analysis.(A, B, C)
4. To provide the student with knowledge and analysis skills associated with frequency response and vibration isolation. (A, B, C)
5. To provide the student with some knowledge and analysis skills associated with automatic controllers and system response specification. (A, B, C)
6. To provide the student with some knowledge and skills associated with using computer software (MATLAB) in analyzing dynamics systems and control systems. (A, B, C)

Topics[2]:

1. Complex Algebra, Linear Algebra, Laplace Transforms, Inverse Laplace Transforms (3 hrs)
2. Linear Differential Equations (3 hrs)
3. Modeling of Mechanical Systems (6 hrs)
4. Block Diagrams, Transfer Functions (3 hrs)
5. Electrical Systems, Electromechanical Systems (3 hrs)
6. Transient Response Analysis (3 hrs)

7. Impulse Response (3 hrs)
8. Analysis in Frequency Domain, Frequency Response, Vibration Isolation (6 hrs)
9. Feedback Control Systems and Automatic Controllers (6 hrs)
10. System Response Analysis and Specification (3 hrs)

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 develop mathematic models of mechanical, electrical and electromechanical systems. (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 perform transient response analysis. (1,2) (a,e,h,k)
Objective 4
4.1. Students will demonstrate an ability to perform frequency response analysis and apply it to vibration isolation problems. (1,2) (a,c,d,e,k,o)
Objective 5
5.1 Students will demonstrate an ability to analyze the response of feedback control systems and specification of automatic controllers. (1,2) (a,k,n,o)
Objective 6
6.1 Students will demonstrate an ability to apply computer software to analyze dynamics systems and feedback control systems. (1,2) (a,k,n)

Prepared by: Z. Ji Date: September 21, 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.