ME 305 - Modeling and Analysis of Dynamic Systems

Catalog Data:	**ME 305: Modeling and Analysis of Dynamic Systems. 3(3,0).** Techniques for developing and analyzing physical and mathematical models of mechanical and electromechanical systems are presented. Transient and frequency response are determined using analytical and numerical methods. Basic feedback systems are introduced. *Preq:* ECE 307, EM 202, ME 202, 205, MTHSC 208.
Textbook:	W. J. Palm III, System Dynamic, McGraw-Hill, 2005.
Reference:	None
Coordinator:	J. R. Wagner, Associate Professor of Mechanical Engineering

Objectives[1]:

1. To teach students to develop accurate models for dynamic electromechanical systems. [B,F]
2. To train students to analytically and numerically solve for the transient and forced response. [B,D,J,F]
3. To teach students to design the system parameters to achieve a desired response. [D,J,F]

Pre/Co-requisites by Topic:

1. Classical dynamics of mechanical systems (kinetics and kinematics of particles and rigid bodies). (EM 202, ME 202)
2. Classical solution techniques for ordinary differential equations (ODEs), including Laplace transforms. (MTHSC 208)
3. Complex and matrix algebra. (MTHSC 206, ME 205)
4. Numerical solution methods for ODEs. (ME 205)
5. Circuit analysis. (ECE 307)

Topical Outline:

1. Course organization and introduction. (2 hours)
2. Modeling of translational and rotational mechanical systems. (6 hours)
3. Modeling of electromechanical systems. (4 hours)
4. Linearization. (3 hours)
5. Standard forms of linear differential equations. (2 hours)
6. Application of linear differential equations, Laplace transforms, and transfer functions to mechanical systems. (6 hours)
7. Frequency response. (6 hours)
8. Design of system parameters to achieve a desired response. (6 hours)
9. Design of basic feedback systems including block diagrams. (5 hours)
10. Tests. (3 hours)

[1] Letters in brackets refer to the ME Program Educational Objectives.

Design Projects:

Several design projects will be assigned that are consistent with the topical coverage. These may include modifying an existing system to reduce the force transmitted to a support or the design of an automobile suspension system to improve ride comfort.

Computer Usage:

A software package, such as MATLAB, is used extensively in regular homework assignments and in projects for analysis and simulation of linear systems.

Evaluation Methods:

1. Homework = 10%
2. Design Projects = 30%
3. Tests = 30%
4. Final Exam = 30%
5. Laboratory Reports = 0%

Student Learning Outcomes[2]:

Course Objective 1

1. Students will be able to identify translational and rotational mechanical components, electrical components, and electric motors. [1,2,3,4]
2. Students will demonstrate that they can apply Newton's second law and Kirchhoff's Laws. [1,2,3,4]

Course Objective 2

1. Students will be able to numerically simulate the response of electromechanical systems using MATLAB or SIMULINK. [1,2]
2. Students will be able to analytically solve linear ordinary differential equations. [1,2,3,4]

Course Objective 3

1. Students will demonstrate the ability to design the system parameters to achieve a desired response. [1,2]

Engineering Topics:

Engineering Science: 2 credits
Engineering Design: 1 credit

Prepared by: J. R. Wagner

[2] Numbers in brackets refer to evaluation methods used to assess student performance.