ME 37500
SYSTEM MODELING AND ANALYSIS

Course Outcomes  [Related ME Program Outcomes in brackets]
1. Introduce a systematic and unified system level modeling of lumped dynamic systems in different domains using first principles.  [A1, A2]
2. Provide necessary mathematical tools for analyzing and predicting the performance of an engineered system based on its dynamic response.  [A1, A2]
3. Provide an introductory treatment of designing feedback controllers to achieve closed-loop stability and specified system performance.  [A1, A2]

Dynamic Modeling (4 wks)
1. Introduction to General Modeling Procedure
2. Standard Forms of Models
   - State Variable Model
   - Input/Output Model
3. Mechanical Systems
   - Translational
   - Rotational
4. Electrical Systems
5. Electro-Mechanical Systems
6. Hydraulic (Fluid) Systems
7. Thermal (Heat Transfer) Systems

System Analysis (6 wks)
1. Dynamic Response
   - Steady State
   - Transient
2. Laplace Transform
   - Solution to ODE
3. Transfer Function
4. Pole Position & System Response
5. Stability Concept
6. Frequency Response
   - Bode Diagram
7. Block Diagram

Feedback Control Design (5 wks)
1. Structures & Feedback Control
2. Performance Specifications
   - Steady State
   - Transient
   - Relation to Pole Position
3. Design Procedure
4. Root Locus
5. PID Control
1. COURSE NUMBER AND NAME:  ME 37500 System Modeling and Analysis

2. CREDITS AND CONTACT HOURS:  3 credits
   a. Lecture – 3 days per week at 50 minutes for 16 weeks

3. COURSE COORDINATOR OR INSTRUCTOR:
   G. B. King

4. TEXTBOOK:

5. SPECIFIC COURSE INFORMATION:
   a. Catalog Description:  This course provides an introduction to modeling electrical, mechanical, fluid, and thermal systems containing elements such as sensors and actuators used in feedback control systems. Modeling techniques based on physical laws and principles are used to generate subsystem and system transfer functions. Closed-loop system analysis will include the use of proportional, integral, and derivative elements to control system response. Typically offered in fall and spring.
   b. Prerequisites:
      ME 36500 – Systems and Measurements
      MA 30300 – Differential Eqns & Partial Differential Eqns for Engineering & the Sciences
   c. Status:  Required

6. SPECIFIC GOALS FOR THE COURSE
   a. Course Outcomes:
      [Related ME Program Outcomes in Brackets]
      1. Introduce a systematic and unified system level modeling of lumped dynamic systems in different domains using first principles. [A1, A2]
      2. Provide necessary mathematical tools for analyzing and predicting the performance of an engineered system based on its dynamic response. [A1, A2]
      3. Provide an introductory treatment of designing feedback controllers to achieve closed-loop stability and specified system performance. [A1, A2]

   b. Related ME Program Outcomes:
      [Related ABET Outcomes Listed in Brackets]
      A1. Engr Fundamentals;   B3. Prof/Ethical Responsibility;
      A3. Experimental Skills; B5. Life-Long Learning;
      A4. Modern Engr Tools;  C1. Leadership,
      A5. Design Skills;      C2. Global Engineering Skills;
      A6. Impact of Engr Solns;  C3. Innovation;
      B1. Communication Skills;  C4. Entrepreneurship
      B2. Teamwork Skills

7. LIST OF TOPICS:  See following page

PREPARED BY:  G. B. King
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