1. Department, Course Number, and Course Title:

MECHANICAL ENGINEERING

ME 410 CONTROL OF MECHANICAL SYSTEMS

2. Designation:

Required	☐	Elective	☑
Lower Division	☐	Upper Division	☑

3. Course Description: Mathematical models of dynamic systems, fundamentals of feedback control, basic control action and devices, application to mechanical systems.

4. Prerequisites: CE/ME 303, Fluid Mechanics; ME 306, Heat Transfer I; CS 290, Introduction to Fortran programming; MATH 215, Differential Equations.

5. Text and Materials: Modern Control Engineering, Third Edition, Katsushiko Ogata, Prentice-Hall, 1997

6. Course Objectives: To provide basic understanding of dynamic system behavior of engineering systems. To introduce elements and concepts involved in design of single-input, single-output feedback control systems. To teach application of analytical, graphical, and computer-aided methods used in design and analysis of feedback control systems.

Course Outcomes

- an understanding of the basic concepts and elements of automatic and feedback control system.
- an understanding of dynamic behavior of physical and engineering systems.
- an ability to develop mathematical models for simple linear lumped parameter dynamic systems.
- an ability to apply Laplace transform and other mathematical methods to predict the response of simple linear systems to various inputs.
- an appreciation of transient versus steady state response.
- a basic understanding of control actions and devices that realize such actions.
- an understanding of concept of stability
- an ability to apply analytical, graphical and computer-aided methods used in design of control systems.
- an ability to analyze and design simple single-input single-output control systems.
- an understanding of the contribution of controls as a highly developed and an interdisciplinary engineering science in the recent technological advances and its overall impact in a societal/global context.
- an ability to communicate effectively.
- a desire to be a flexible and adaptable team player.

7. Topics Covered: (in Order of Presentation)

- Dynamic Behavior of Physical Systems (Ch. 1)
- Elements of a Single-input Single-output Control System (Ch. 1)
- Linear Differential Equations and the Laplace Transform Method (Ch. 1)
- Mathematical Models of Physical Systems (Ch. 2)
- Linearization, Analogous Systems , dc Motors Sensors (Ch. 2)
- Proportional, Integral, Derivative, and PID Control Actions (Ch. 3)
- Time-domain and Frequency-domain Characterization of Transient Response (Ch. 4)
- Error Analysis, Parameter Optimization (Ch. 4)
- Steady State error and Stability of Feedback Control Systems, Routh's Stability Criterion (Ch. 4)
- The Root Locus Method (Ch. 5)
- Application of Computer-aided analysis and design Methods including MATLAB and SIMULINK. Use On-line Manual and Tutorial
- Case Studies and Discussions of Term Project

8. Class Schedule:

Number of Sessions per week:	2
Duration of each session:	1 hour 40 minutes

9. Contribution of course to meeting the professional component:

This course is part of the 25 units of technical electives required for the mechanical engineering program.

Engineering Science	2 units
Engineering Design	2 units

10. Relationship of course to program objectives:

This course relates to the program objectives by contributing to the following measurable outcomes at the level indicated for all engineering graduates:

Knowledge outcomes:

- an ability to apply knowledge of mathematics, science, and engineering (abet a)
- a knowledge of computer aided design and simulation software
- a knowledge of how mechanical engineering integrates into inter-disciplinary systems

Skill outcomes:

- an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability (abet c)
- an ability to communicate effectively (abet g)
- an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice (abet k)
- an ability to think in a logical sequential process

Attitudes Outcome:

- an understanding of responsibility and accountability
- a desire to be a professional that exhibits values, dedication and a need for continual improvement

11. Prepared by: Maj Mirmirani 12/2005