CLEVELAND STATE UNIVERSITY
Mechanical Engineering Department

MCE 603: Interfacing and Control of Mechatronic Systems

Catalog Description: MCE 603 : Interfacing and Control of Mechatronic Systems (2-2-4). *Prerequisites: MCE 403/503 and MCE441. Permission of instructor required for graduate students without the MCE441 prerequisite.* Study of mechatronic sensors and actuators from the physical principles governing their behavior. Bond graph modeling of specific devices like piezoelectric and magnetostrictive transducers, capacitance sensors, electric motors, charge coupled devices, operational amplifiers, Hall effect sensors and others. Digital control applied to mechatronic systems. Electronic interfacing.

References: Karnopp, D., Margolis, D. and Rosenberg, R., System Dynamics: Modeling and Simulation of Mechatronic Systems, Third Edition, Wiley Interscience, 2000; and Bishop, R., editor, Mechatronics Handbook, CRC Press, 2002

Coordinator: Hanz Richter, Assistant Professor, Mechanical Engineering

Course Objectives: This course is designed to:
Enable students to apply modeling and simulation skills to the study and design of individual mechatronic sensors and actuators and to interconnected systems. Become familiar with the design and operation of such devices through laboratory experiences. Introduce students to theoretical and implementation aspects of digital control.

Expected Outcomes: Upon completion of this course, students should be able to:
- Obtain dynamic models of mechatronic devices and systems
- Design model-based digital controllers for linear mechatronic systems using software packages
- Design and/or select appropriate interfaces for computer control
- Implement rapid control prototyping systems using real time simulation software and hardware

This course fulfills the following objectives and outcomes of the Mechanical Engineering Program:

Objectives:
Practice mechanical engineering in Fluid Thermal/Energy Conversion and/or Machine System stems of the discipline in private, government or industrial organizations.
Practice mechanical engineering in environments that require a variety of roles including engineering problem definitions, application of advanced methods of analysis, problem diagnosing, solution of real-world engineering design problems that are subject to realistic constraints such as cost, safety, etc.
Take the role of a team member or team leader in the engineering profession of

their employment, in professional organizations.
Enhance their knowledge beyond BS level, a life long learner, and keep current with the advancements in engineering and technology.

Outcomes:
Ability to apply math, science, and engineering knowledge.
(c) Engineering design of mechanical systems, units and processes.
(e) Identification, formulation and solution of engineering problems.

Prerequisites by Topic:

Differential Equations
Electrical Circuits
Computer Programming
Control Systems

Topics	**Lecture/Lab Hours**
1 Course introduction.	1
2 Review of bond graph-based modeling	3
3 Sensing technologies and sensor modeling	8
4 Actuator technologies and actuator modeling	8
5 A/D, D/A conversion and mechatronic system interfacing	6
6 Fundamentals of discrete-time systems and digital control	10
7 Guided project work: model generation	5
8 Guided project work: controller design	5
9 Guided project work: controller implementation	8
10 Final group presentations	4
11 Holidays	2
Total lecture/laboratory hours	60

Computer Usage: Matlab will be used for numerical simulation. Other specialized software will be introduced and provided for automatic modeling tasks and for real-time control.

Prepared by: Dr. Hanz Richter Date: April 20, 2005