Course Outline for ENGR 416: Mechatronics Lab

Elective
Electrical and Mechanical Engineering

Bulletin Description
ENGR 416: Mechatronics Lab (1 unit)
Prerequisites: ENGR 415
Experiments connected with mechatronic concepts. Programming robot tasks.
Comparison and analysis of human and robot motion. Optical encoders, motor selection
and tuning.

Textbook
Richard H. Barnett, Sarah A. Cox, Larry D. O’Cull. Embedded C Programming and the

References

Coordinator
Mike Holden, Assistant Professor of Engineering

Prerequisites by Topic
1. Basic kinematics and dynamics
2. Circuit theory
3. Operational amplifiers
4. Signal conditioning
5. System concepts. System transfer functions.
6. Time and frequency response. Basic Control Theory

Course Objectives
The purpose of the lab is to give the students hands–on experience with the mechatronic
systems described in the lecture portion of the course. The labs in the first half of the
semester will be one to two week labs designed to give the students an introduction to the
tools available. The second half of the semester will be used to build a mechatronic
project, using some of the systems introduced in the first part of the semester.

1 Indexes in brackets refer to the educational objectives and outcomes of the School of Engineering.
1. Sensors: Understand how common sensors, signal conditioning circuits and filters are used. [A.1, A.3, A.4, B.1, B.2, B.3]
2. Controllers: Students will be able to use controllers such as microcontrollers, PLC’s and personal-computer based controllers for mechatronics projects. [A.1, A.3, A.4, B.1, B.2, B.3]
3. Actuators: Students will be able to integrate common actuators and their control electronics into a mechatronics project. [A.1, A.3, A.4, B.1, B.2, B.3]

The students will work in small groups. Because of the multidisciplinary skills required for mechatronics, each group must have at least two different engineering majors represented.

**Topics**

1. Sensors, amplification and filters. Students will learn how to scale sensor outputs to the range needed by common controllers. Students will learn when the application of RC or active filters are necessary for sensor use.
2. Microcontrollers (Atmel) in control and automation. Students will learn how to program an 8-bit Atmel microcontroller using the gnu c compiler and a boot loader, and how to debug the program using the Atmel simulator. The Atmel peripherals will be introduced with the aim of providing a skeleton program to be used for control applications.
3. Use of PLCs for mechatronic systems. Students will learn how to write a ladder-logic program and run it on the School’s PLC systems.
4. Personal computers (DSPACE) for control and automation. Students will learn how to create a simulink block diagram with DSPACE inputs and outputs, and implement a control law using the DSPACE system and MATLAB.
5. Motors: DC Motors, stepper motors, hobby servo motors. Students will control the various motors using the controllers (Micro, PLC or PC) from the previous labs.

**Professional Component**

- Engineering Science 50%
- Engineering Design 50%

**Evaluation**

1. Structured Labs 60%
2. Project 40%

**Performance Criteria**

Objective 1

1.1 The student will experiment with sensors, amplification and analog filters. [1, 2]
1.2 The student will design and build a mechatronic system using a sensor. [2]

2 Numbers in brackets refer to the evaluation methods used to assess student performance
Objective 2
2.1 The student will program and use Atmel microcontrollers, Siemens PLCs and dSpace controllers. [1, 2]
2.2 The student will design and build a mechatronic system using a controller. [2]

Objective 3
3.1 The student will experiment with DC motors, H-bridges and hobby servomotors. [1, 2]
3.2 The student will design and build a mechatronic system using an actuator. [2]

Spring Semester, 2005
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Class/Laboratory Schedule
One 2-hour-45-minute lab session/week

Prepared by
Mike Holden, spring, 2005