AE 6705 - Syllabus

Introduction to Mechatronics. 4 Credit Hours.

General Information

Description

Modeling and control of actuators and electro-mechanical systems. Performance and application of microprocessors and analog electronics to modern mechatronic systems.

Pre- &/or Co-Requisites

Appropriate undergraduate course(s) in controls and system dynamics.

Course Goals and Learning Outcomes

Outcome 1: Students will develop a solid understanding of the various components of the interface between mechanical and electronic systems which comprise microcontroller units (MCUs).

1.1 Students will demonstrate an understanding of integer and floating point math, and will understand the concepts of finite precision and rollover.
1.2 Students will be able to develop embedded C programs of moderate complexity capable of executing feedback control of mechanical systems using an MCU.
1.3 Students will gain experience with analog-to-digital conversion, serial communications, interrupts, timers, and volatile/non-volatile memory.

Outcome 2: To educate students about actuator devices and appropriate methods of powering and controller actuator mechanisms.

2.1 Students will demonstrate knowledge of operation of brushed and brushless DC motors.
2.2 Students will demonstrate knowledge of stepper motors and stepper motor drive circuits.
2.3 Students will be able to develop appropriate actuator control software and hardware using pulse width modulation, H-bridge circuits, and power MOSFETs.

Outcome 3: To educate students about sensor devices and appropriate methods of powering sensors, reading sensor data, and conditioning sensor data for use in control algorithms.

3.1 Students will demonstrate knowledge of sensor signal characteristics such as noise, bias, range, accuracy, sensitivity, resolution, hysteresis, and repeatability.
3.2 Students will be comfortable using various types of sensors including encoders, transducers, proximity sensors, Hall effect sensors, and others. Students will be able to required sensor specifications to produce a desired mechatronic system functionality.
3.3 Students will be able to design hardware filters and software filters for the purpose of signal conditioning.

Outcome 4: To educate students about feedback control and system modeling for the purposes of efficiently designing and implementing mechatronic systems.

4.1 Students will be able to construct an input-output system block diagram for an arbitrary mechatronic device.
4.2 Students will be able to derive equations of motion for a mechanical system, apply the Laplace transform, and generate open and closed loop transfer functions using PID control.

4.3 Students will be able to utilize simulation models for control design and understand performance differences between simulated and experimental systems.

4.4 Students will be able to design, construct, simulate, and control in a feedback manner a mechatronic device which performs some specified functions.

Course Requirements & Grading

Note: Graded components of a course may vary with each offering. The example below is typical but subject to change.

Description of Graded Components

The course graded components consists of 10 graded lab assignments as well as a final project.

Grading Scale

Your final grade will be assigned as a letter grade according to the following scale:

A	90-100%
B	80-89%
C	70-79%
D	60-69%
F	0-59%

Topics Covered

Note: The exact topics covered in a course may vary with each offering. The example below is typical but subject to change.

- Overview of embedded systems
- Embedded C programming
- Microcontroller peripherals, general purpose input/output
- Analog-to-digital conversion
- Serial communication
- Actuator specification and integration
- Sensor specification and integration
- Feedback control implementation

Course Materials

Note: Course materials may vary with each offering. The example below is typical but subject to change.

Textbook

Jouaneh, M., Fundamentals of Mechatronics, Cengage Learning, 2013 (available from Amazon.com), ISBN 978-1-111-56901-3

Course notes

Course notes are provided each week on Canvas. Example codes are shown in class and occasionally provided on Canvas.