Course Syllabus

SUNY MEC450/550: Mechatronics
Spring 2024

Course Detail

Title: MEC450/550: Mechatronics

Credit: 3

Classroom Location:

Prerequisites: MEC310, MEC316, MEC411

Instructor Detail

Instructor: Seung-Bok Choi, Ph.D.

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Course Description

An introduction to the design, modeling, analysis, and control of mechatronic systems (smart systems comprising mechanical, electrical, and software components) is lectured as a first step. Fundamentals of the basic components needed for the design and control of mechatronic systems, including sensors, actuators, data acquisition systems, microprocessors, programmable logic controllers, and I/O (input/output) systems, are covered. Hands-on experience in designing and building practical mechatronic systems is provided through integrated lab activities. Especially, signal conditioners associated with PID (proportional-integral-derivative) controller are to be made by students.

Course Learning Objectives

1. Familiarity with Basic Configuration of Mechatronics
2. Familiarity with Basic Control Theory and Stability
3. Familiarity with Types of Sensors and Actuators
4. Familiarity with Signal Conditioning
5. Mechatronics Example- Robot Control

Textbook: W. Bolton, Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, 6th Edition, Pearson, 2015 (ISBN-10: 1292076682): Textbook

References:

1. D. G. Alciatore, Introduction to Mechatronics and Measurement Systems, 5th Edition, McGraw-Hill Education, 2018 (ISBN-10: 1260048705)
2. K. Shin and J. Hammond, Fundamentals of Signal Processing for Sound and Vibration Engineers, John Wiley & Sons Ltd, 2008 (ISBN-10: 0470511885)
3. T. G. Beckwith et al, Mechanical Measurements, 6th Edition, Pearson 2007 (ISBN-10:0201847655)

Homework Assignment

1. Homework assignments will be assigned in the class.
2. Homework must be handed in at the end of the class on the specified due date.
3. I will accept your homework as PDF file sent to my email address only.
4. Late homework will cause the deduction of the score.
5. Do not forget to write your name and ID on the top of the first page.

Individual Lab Practice

1. Each student should carry out at least two different experiments regarding to the signal conditioning or PID controller:

   Possible Candidates:

   ① Design of OP Amplifier Circuit and Test (mandatory)
   ② Design of Integrator Circuit and Test (mandatory)
   ③ Design of Differentiator Circuit and Test (mandatory)
   ④ Design of Low and High Pass Filter (optional)

Personal Project for Robot Control

1. Choose arbitrary robot.
2. Control of end effector (gripper)
3. Presentation of progress at least 2 times
4. PPT final presentation and submit the PPT file.

Class Examination

1. There will be only one exam (150 minutes) and the date will be announced two weeks in advance.

Grading Distribution

1. **Attendance 10%**
2. **Homework and Experiment: 30%**
3. **Examination: 40%**
4. **Personal Project: 20%**

Grading Scale

1. The final grade will be absolute based the following points

   A: 95-100, A-: 90-95

   B+: 85-90, B: 80-85, B-: 75-80

   C+: 70-75, C: 65-70, C-: 60-65

   D+: 55-60, D: 50-55

   F: below 50

2. For graduate student: F: below 60

Tentative Course Schedule

Week 1: Introduction to Mechatronics

Week 2: Classification of Mechanical Systems & Modeling

Week 3: Transient and Steady State Responses (Matlab Practice)

Week 4: Feedback Control Theory

Week 5: System Stability

Week 6: Measurement of Mechanical Parameters

Week 7: Analog Circuits and Signals

Week 8: Digital Circuits and Signals

Week 9: Signal Conditioning (Theory)

Individual Lab Assignment

Week 10: Written Examination (to be changed)

Week 11: Robot Introduction

Week 12: Robot Kinematics

Week 13: Robot Dynamics

Week 14: Robot Control

Week 15: Project Concept Presentation

Week 16: Project Progress Presentation

Week 17: Project Final Presentation (PPT)

What is the Mechatronics?

Mechatronics = **Mecha** from Mechanism and **Tronics** from Electronics (firstly used by Japanese engineer); **Mecha**nical + Elec**tronics**

The integration of mechanical engineering with electronics and control functions including sensors, actuators, microprocessors, signal conditioning, data acquisition system, etc.

- Control Theory
- System Response
- Sensors and Actuators
- Signal Processing and Conditioning
- Microprocessor
- Data Acquisition System (DAS)

Ex)

1) Position Control of Satellite
2) UAV, UAM, Drone Taxi
3) Vibration Control Bridge System
4) **Best Representative System for Mechatronics:**

   Robot Control: We will learn about this.