Course Syllabus

SUNY MEC450/550: Mechatronics
Spring 2021

Course Detail

Title: MEC450/550: Mechatronics
Credit: 3
Classroom Location: B206
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 Analog and Digital Circuits
5. Familiarity with Signal Conditioning with Experiment

6. Familiarity with Microprocessor Systems with Experiment

References

1. **W. Bolton, Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, 6th Edition, Pearson, 2015 (ISBN-10: 1292076682): Textbook**
2. D. G. Alciatore, Introduction to Mechatronics and Measurement Systems, 5th Edition, McGraw-Hill Education, 2018 (ISBN-10: 1260048705)
3. K. Shin and J. Hammond, Fundamentals of Signal Processing for Sound and Vibration Engineers, John Wiley & Sons Ltd, 2008 (ISBN-10: 0470511885)
4. 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 or posted on blackboard.
2. Homework must be handed in at the end of the class on the specified due date.
3. You can either hand-write your solutions to homework or type them.
4. I will accept your homework sent to my email address at special situations.
5. Late homework will not be accepted in any case.
6. Homework should be done on A4 sized papers and be stapled neatly.
7. 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:

   Possible Candidates:

   ① OP Amplifier Circuit and Test

   ② Integrator Circuit and Test

   ③ Differentiator Circuit and Test

   ④ Low and High Pass Filter

2. Lab report including the experimental name, circuit design, method, result and discussion for three different hardware should be submitted on the due date to be announced.

Team Project for Control Theme

1. Students should form 3 groups to carry out the predetermined control projects.
2. Two normal groups and one challenging group (graduate students only) are to be formed for difficulty balance.
3. Each group must design, build, test, and demonstrate a mechatronic device which meets the project requirements.
4. Each group should estimate the cost as soon as the project is assigned and report to the instructor and class assistant.
5. Lab report should be submitted on the final presentation date. The report, of course, should be a standard form including the title, abstract, motivation, related theory, experimental apparatus and method, results and discussion, conclusion and future works, and references.
6. Each group should present control results via both PPT and hardware operation.
7. The PPT presented at the final presentation should be also submitted on the presentation date.

Possible Candidates:

① Position Control of Servomotor with different Shaft Inertia (Mass)

② Vibration Control of a Cantilever Beam Using Piezo Actuator and Sensor

③ Position and Vibration Control of a Single-Link Flexible Arm Using Servomotor and Piezo Actuator/Sensor

④ Position Control of an Inverted Pendulum Using Servomotor

Class Examination

1. There will be two class examinations (90 minutes examination) with competency questions.
2. The examination date will be announced two weeks in advance

Grading Distribution

1. Attendance and Homework: 10%
2. Midterm Examination: 25%
3. Final Examination: 35%
4. Individual Lab Report: 10%
5. Group Lab Report and Presentation: 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 (PID Controller)

Week 5: System Stability

Week 6: Measurement of Mechanical Parameters

Week 7: Analog Circuits and Signals

Week 8: Digital Circuits and Signals, **First Class Examination**

Week 9: Signal Conditioning (Theory), Individual Lab Assignment

Week 10: Signal Conditioning: **Validation of Circuits via Experiment**

Week 11: Sensors and Transducers

Week 12: Actuators

Week 13: Microprocessor (A/D, D/A, DAS, etc), dSpace: Experimental Demo

Week 14: Check and Discussion on Group Project

Week 15: Q & A for Group Project, **Second Class Examination**

Week 16: Final Presentation for Group Project: **PPT Presentation and Hardware Demonstration**