MECH 421: Mechatronic System Instrumentation

2019-2020 Term 2

Last updated: Jan 17, 2020

Objectives

Learn a systematic way of integrating together what you have learned in previous courses, such as electronics, linear time-invariant (LTI) systems, sensors and actuators, mechanical systems, feedback control, and signal processing.

Contact Information

Instructor:	Dr. Minkyun Noh	(mnoh@mech.ubc.ca, KAIS 3105)
TA:	Zhao Wei (Victor) Lu	(zhaoweil@mail.ubc.ca)
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Lectures

Lectures are a main means of delivering MECH 421 contents and announcements. There will be 25 lectures including an in-class mid-term exam. Lecture notes will be posted on CANVAS. There is no required text book.
- Time: Mon 3-4pm and Fri 10-11am
- Location: CEME 1215

Labs

Labs are a major component of MECH 421. There will be 4 labs during the course.
- Lab 1: Voltage power amplifier
- Lab 2: Transconductance power amplifier
- Lab 3: Motor position servo loop design
- Lab 4: Conveyer belt control

For each lab, students are asked to submit a prelab report and a lab report. Manuals for prelab and lab reports will be posted on CANVAS in advance. During the lab, students will perform activities in groups of 4-5 students. Group members are encouraged to collaborate during the lab activities, but NOT for the prelab and lab reports; each group member should come up with their own prelab and lab reports based on their individual effort. Each student MUST submit a prelab report to participate in the lab session. Late submission of a prelab report is not accepted. Late submission of a lab report will incur score deduction of 10% per day.
- Prelab report due: at the beginning of the lab session
- Lab report due: at the beginning of the next lab session (except the last one)

Due to the space constraint, students are distributed over 4 lab sessions (A to D). Please check which lab session you are assigned to.
- Time: Tue 8am-10am, Tue 10am-12pm, Thu 8am-10am, or Thu 10am-12pm
- Location: KAIS 1230

Problem Sets

There will be 10 problem sets during the course. Each problem set will be posted on CANVAS a week before the due date. Late submission will incur score deduction of 10% per day.

- Problem set due: at the beginning of the Friday lecture

Exams

- Mid-term: Feb 24th in class. 1 sheet of note (Letter-size, double-sided) is allowed.
- Final: 2.5hrs. 2 sheets of note (Letter-size, double-sided) are allowed.

Tutorials

Time: Wed 2-3 pm
Location: West Mall Swing Space Room 205.

Office Hours

Instructor: Mon 2-3 pm at KAIS 3105, after lectures, or by appointment
TA: by appointment

Course Grading

Prelabs (15%) + Lab (20%) + Problem sets (10%) + Mid-term exam (25%) + Final exam (30%)

Course Schedule (Tentative)

Week	Date	Lecture	Labs	Psets
1	Jan 6 Jan 10	Introduction Op-amp static model		
2	Jan 13 Jan 17	Linear circuits review LTI system frequency-domain representations		HW1
3	Jan 20 Jan 24	Op-amp dynamic model Feedback and stability		HW2
4	Jan 27 Jan 31	Loop shaping review Voltage amplifier driving brushed DC motor		HW3
5	Feb 3 Feb 7	Transconductance amplifier design Transconductance amplifier driving brushed DC motor	Lab 1	HW4
6	Feb 10 Feb 14	Instrumentation amplifier Op-amp non-idealities		HW5
7	Feb 17 Feb 21	**Midterm Break**		
8	Feb 24 Feb 28	Mid-term exam Dynamics of motion systems	Lab 2	
9	Mar 2 Mar 6	Loop shaping: lead controller design Loop shaping: PI controller design		HW6
10	Mar 9 Mar 13	Digital control implementation via approximate mapping Digital control design based on ZOH equivalent		HW7
11	Mar 16 Mar 20	ADC topics: sampling, aliasing, quantization, etc. DAC topics: reconstruction, delay, etc.	Lab 3	HW8
12	Mar 23 Mar 27	Random noise and power spectral density Electromagnetic interference reduction techniques		HW9
13	Mar 30 Apr 3	Linear amplifier power analysis Introduction to power electronics	Lab 4	HW10
14	Apr 6	Summary of the course		