ENEL 441, Winter 2020, Control Systems I
Introduction Notes

What is this note about?

First, welcome to ENEL441 for the winter 2020 term, and all the best with your upcoming semester!

This note is a summary of the items that you need to know regarding this course in one place (hopefully). Please read it as it should answer most of your course administration type questions. If not, any further questions or concerns you may have you can always contact me at:

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Note that there will be changes to this note as the TA's and lab schedule becomes finalized.

My Office hours

I don't like to hold specific office hours so anytime I'm in my office you are welcome to ask about ENEL441 related stuff. You can always call or email to set up a specific time to meet. I will try to answer emails in a timely fashion but sometimes they come in bunches so that response time can be slow. If the questions are related to the marking of quizzes or labs then please contact the TA's first.

Who are the TA's for ENEL441 and what are their roles?

This year we have four TA's for ENEL441, selected based on the criteria of being very knowledgeable in the subject area of control systems, Matlab and Simulink. Hence they are capable and available to help you with the course content and especially the labs. They will be responsible for marking the quizzes and the labs. A schedule of which TA marks which lab and which quiz will be posted on D2L before classes start.

TA	email	Role
Kiana Karami	kiana.karami@ucalgary.ca	Lab TA Grade: L2
Mahmood khalghollah	mahmood.khalghollah@ucalgary.ca	Grade: Q3, Q6, L1
Gayan Brahmanage	gayan.brahmanage@ucalgary.ca	Grade: Q2, Q5, L3
Vatsala	vatsala@ucalgary.ca	Grade: Q1, Q4, L4

The right column indicates the labs and quizzes that each TA will be responsible for in terms of grading. All graded quizzes will be available during the Thursday lab periods. Labs will be graded on D2L.

Timetable

The location of the lectures, labs and tutorials are listed in the table below.

activity	Days of the Week	Time	Location
lecture	Tue/Thur	9:30 am-10:45 am	MFH 160
labatorial	Thur	2 pm – 4:50 pm	ENG203
Tutorial/quiz	Wed	11:00 am-11:50 am	MFH 160

Examinations

The following examinations will be held in this course:

Quizzes: There will be quizzes every other Wednesday morning for the first 30 minutes of the tutorial period starting at 11:00 am. All quizzes will be closed book, non-communicating calculator is allowed. Aid sheets associated with the quizzes will be provided as part of the quiz paper and will be posted on D2L prior to the quiz. There will be 6 quizzes total and the mark for the quiz component will be the **best 5 quiz marks out of the 6**. Hence you can ace the first 5 quizzes, feel free to skip the last one. Weekly quizzes are designed to help you keep up with the material and as you will note there is no midterm. The downside is the pain of Wednesday morning quizzes.

Final Exam: There will be a final exam of 3 hrs duration will be closed book, no calculator. An aid sheet will be provided for the final exam that will be posted on D2L

Non-communicating calculators will be allowed for quizzes and final exam, however no other aids are allowed.

Final Grade Determination

The final grade in this course will be based on the following components:

Component	Weight
Weekly Quizzes (best 5 quiz marks out of 6 quizzes)	35%
Laboratory	20%
Final Exam	45%

100%

Textbook

The following textbook is a highly recommended reference for this course:

Title	Control Systems Engineering
Author(s)	Norman S. Nise
Edition, Year	Eighth Edition (earlier editions are sufficient but page numbering will not be exact)
Publisher	Wiley

This textbook is an excellent resource for the course and all of the lecture material is taken from this textbook. However, we will not follow the textbook exactly and all the lecture notes will be posted on D2L in the contents area. Hence while it is highly recommended that you obtain a copy of this textbook and study from it, it is not absolutely imperative that you do so. Your call.

What are we doing for the control I labs?

There are three objectives of the four labs that you will be doing:

1. Introduce analysis and simulation tools – Matlab control system toolbox and Simulink

2. Introduce discrete time sampled digital control system implementations

3. Implement a control system on a microcontroller

The four labs are listed below:

1. Introduction to Matlab control system toolbox and Simulink for continuous time system analysis – This is intended as a gentle introduction to using Matlab and Simulink for control systems analysis.

2. Dynamic models and responses – SISO feedback loop modelling in Simulink. A car suspension system will be modelled with linear transfer functions and simulated in time domain using Simulink.

3. Design of compensators - design of a continuous time compensator for a control loop. Time domain simulation in Simulink. Also account for nonlinearities.

4. Digital discrete time control loop – – Introduction to discrete time sampling digital processing based on a microcontroller. Analysis of a transfer function consisting of electrical components that are sampled in discrete time. Design a P and PI compensator for implementation on a small microcontroller and determine responses

The labs are posted in the D2L under the 'content' tab. As stated above, you will complete a lab report for each of the four labs. Lab submission is done by a soft copy uploaded with the D2L dropbox for each lab. You can either submit the lab reports individually or with a lab partner. Just make sure that your name and your partners name appear on the lab report such that the TA's can credit your assignment work.

The lab sessions on Thursday afternoons are for you to drop in and work on your lab assignment with the TA's present to give you assistance as needed. Even though your student schedule outlines a specific block you are in, disregard this and use any available lab time as a 'labatorial'.

Assignment and lab due dates

The first lecture will be Tuesday January 14
Reading week is Feb 16-21 so no lectures, tutorials or lab sessions that week

There will be four labs which are essentially Matlab/Simulink programming and analysis labs with reports due for each. You can pair up so that either one or two students per submitted lab report. The due dates for the lab reports are:

lab	**Due date**
1	Feb 7
2	Feb 28
3	March 20
4	April 10

They can be submitted up to 11:59pm of the date given in the table above via the D2L dropbox for the specific lab. As it is necessary to impose a penalty for late lab report submissions, this is set at 10% drop in grade for every school day that it is late (unless you have a really, really good excuse).

The dates for the 6 quizzes given approximately every other Wednesday are listed below:

Quiz	**date**	**Topic**
1	Jan 29	Laplace forward and reverse, transfer functions, impulse response, poles and state space intro notes and **unit 1**
2	Feb 12	Mechatronic models **Unit 2**
3	Feb 26	Feedback design – stability and steady state, **unit 3**
4	March 11	Feedback loop analysis methods Root Locus and Nyquist, **unit 4**
5	March 25	Compensator design methods, **unit 5**
6	April 8	Digital control loops and state space **unit 6**

What is covered in the course and what sections in the text do I need to study?

The course is organized into 6 modules which are based on the chapters in the textbook. Below is a table of the content of each unit, what is covered in the text and what is covered in the quizzes.

unit	description	textbook section	quiz
1	Introduction and Laplace review, Systems modelling with Laplace analysis, Transfer functions, electrical systems State space analysis	1.3-1.5 2.1-2.4 3.1-3.4,3.6	**Q1**
2	Mechanical transfer functions – displacement and rotational Gears, motors, mixed models Intro to mechatronics	2.5-2.7	**Q2**
3	Time domain response Feedback design Stability and steady state errors	4.1-4.8 5.2,5.3,6.5 Chapter 7	**Q3**
4	Feedback loop analysis methods root locus analysis Nyquist plots – frequency domain analysis	Ch 8	**Q4**
5	Compensator design methods - root locus and frequency domain	Ch 9 10.1,10.2,11.2-11.4	**Q5**
6	Introduction to digital control	parts of ch.12 and ch.13	**Q6**