Université d'Ottawa
Faculté de génie

École d'ingénierie et de technologie de l'information

uOttawa

L'Université canadienne
Canada's university

University of Ottawa
Faculty of Engineering

School of Information Technology and Engineering

ELG 3155 : Introduction to Control Systems (3units)
Winter 2023

Instructor: Hitham Jleed
E-Mail: hjleed@uottawa.ca
Office Hours: 13:00 to 14:30 on Mondays & 11:00 to 12:00 on Thursday.
Schedule: (January 09 - April 12)

TA s
1. Rahil Ghalamboland; (rghal080@uottawa.ca)
2. Futong Li; (fli097@uottawa.ca)
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Section	Activity	Day	Location
ELG3155 A00	LEC	Monday 11:30 - 12:50	CBY B205
ELG3155 A00	LEC	Thursday 13:00 - 14:20	CBY B205
ELG3155 A01	LAB	Tuesday 11:30 - 14:20	STE 3040
ELG3155 A02	LAB	Tuesday 16:30 - 18:50	STE 3040
ELG3155 A03	LAB	Friday 8:30 - 11:20	STE 3040
ELG3155 A04	LAB	Wednesday 19:00 - 21:50	STE 3040
ELG3155 A05	TUT	Tuesday 8:30 - 9:50	CBY B012
ELG3155 A06	TUT	Tuesday 8:30 - 9:50	CRX C030

CALENDAR DESCRIPTION

Introduction to control systems, dynamic systems modeling. Laplace transforms, partial fraction methods. Block diagram and signal flow graph models, transfer functions of linear systems. Introduction to state-space models. Feedback control system characteristics, stability and Routh-Hurwitz criteria, the root locus method, design of industrial controllers, the Nyquist stability criterion, Bode plots, design indexes, lead and lag controllers.

COURSE OBJECTIVES

At the end of the course, you are aimed to be able to:
• Build mathematical models of basic electrical systems and based on these models, have a solid understanding of how to build mathematical models of more complex systems.
• Design basic types of controllers, including P, PI, PID controllers for typical electrical systems.
• Identify dynamic electrical systems, that is build mathematical models and identify the values of the parameters of these models based on experimental input-output measurements.
• Have a good background for studying more advanced controls and control application topics, such as robust control, nonlinear control, adaptive control, robotic control, vehicle stability control, aerospace control, etc.

COURSE COMPONENT: Laboratory, Lecture, and Tutorial.

PREREQUISITES

ELG3125 (Signal and System Analysis).

TEXTBOOK

Nise, Norman S. Control systems engineering. 7th edition, John Wiley & Sons, 2015., ISBN: 978-1-118-80063-8

Student Companion Site (Free) [html] Nise: Control Systems Engineering, 7th Edition - Student Companion Site (wiley.com)

RECOMMENDED TEXTS/MATERIALS

- K. Ogata, Modern Control Engineering, 5th (or any other edition), Prentice Hall.
- C.D. Dorf and R.H. Bishop, Modern Control Systems, 11th Ed. (or any other edition), Prentice Hall

STUDENT EVALUATION

Labs	24 %
Assignment	6%
Midterm	25 %
Final Exam	45 %

Laboratories: Laboratory experiments are done in groups. The labs are in person @ SITE 3040. Each experiment is divided into two weeks – In the first week, students will have the Prelab part (students don't have to attend, they work on the tasks from home. A pre-lab report (one pre-lab report/group) must be submitted before starting the next week. The week after is the actual Lab part (in person @SITE 3040). Another report must be submitted (one lab report/group). The individual contribution of each student will be assessed by the TA. (upload two reports /experiment – one for the Prelab, and one for the Lab.)

Midterm will be closed book on February 27, 2023 in class and cover the topics taught up to the midterm date. (The reading break is from February 19 to 25, 2023.)

Final exam will be closed book and cover all the topics covered by the course.

SYLLABUS

Module	Topic
1-Introduction	Introduction to Control Systems. Course objective and oultline (2 lectures)
2- Modeling in the Frequency Domain	Laplace Transforms and Transfer functions (1 lecture) Modeling of Elec-circuit, Op-amps and Electric Motors (2 lectures)
3 -Modeling in the Time Domain	state-space representation and its applications (1 Lecture) Convert a transfer function to state space and vise versa (1 Lecture)
4 -Time Response	Transient response and system specifications (1 Lecture) Time response of 1st order and 2nd order systems (1 Lecture) More than 2 poles; zeros; nonlinearities and linearization (1 Lecture)
5- Reduction of Multiple Subsystems	Block diagrams and signal-flow graphs (1 Lecture) Mason's Rule (1 Lecture)

6- Stability	Routh-Hurwitz Criterion (2 Lectures) Stability analysis (1 Lecture)
7- Steady-State Errors	feedback system analysis. (1 Lecture) Stead-state error and sensitivity (1 Lecture)
8- Root Locus Techniques	Root locus introduction (1 Lecture) Root locus properties and sketching. (1 Lecture) Design of transient response using root locus (2 Lectures) Generalized Root Locus (1 Lecture)
9- Transient response compensation	Design via root locus and PID (1 Lecture) Transient and steady-state error compensation. (1 Lecture)
10- Frequency Response Techniques	bode plots (1 Lecture) Design using the frequency response; lead, lag, lead-lag compensators (1 Lecture)

COURSE LECTURE NOTES

Unless otherwise noted, all course materials supplied to students in this course are intended for use in this course only. These materials are NOT to be re-circulated digitally, whether by email or by uploading or copying to websites, or to others not enrolled in this course. Violation of this policy may in some cases constitute a breach of academic integrity as defined in the UVic Calendar.

CEAB Accreditation

The graduate attributes covered by the course are:

- GA 1B: Demonstrate competence in mathematics, statistics and probability, and computational methodologies relevant to electrical engineering (Advanced level)
- GA 2A: Demonstrate the ability to identify and characterize an engineering problem (Development level)
- GA 3A: Demonstrate the ability to define the scope and nature of a complex problem (Development level)
- GA 4B: Generate a diversified set of candidate engineering design solutions (Development level)
- GA 10C: Act ethically and demonstrate individual accountability (Development level)

ACADEMIC ACCOMMODATIONS

The University has always strived to meet the needs of individuals with learning disabilities or with other temporary or permanent functional disabilities (hearing/visual impairments, sustained health issues, mental health problems), and the campus community works collaboratively so that you can develop and maintain your autonomy, as well as reach your full potential throughout your studies. You can call on a wide range of services and resources, all provided with expertise, professionalism and confidentiality.

If barriers are preventing you from integrating into university life and you need adaptive measures to progress (physical setting, arrangements for exams, learning strategies, etc.), contact the Access Service right away:

- in person in our office
- online
- by phone at 613-562-5976

Academic Integrity

Academic integrity is intellectual honesty and responsibility for academic work that you submit individual or group work. It involves commitment to the values of honesty, trust, and responsibility. It is expected that students will respect these ethical values in all activities related to learning, teaching, research, and service. Therefore, plagiarism and other acts against academic integrity are serious academic offences.

The responsibility of the institution Instructors and academic units have the responsibility to ensure that standards of academic honesty are met. By doing so, the institution recognizes students for their hard work and assures them that other students do not have an unfair advantage through cheating on essays, exams, and projects.

The responsibility of the student Plagiarism sometimes occurs due to a misunderstanding regarding the rules of academic integrity, but it is the responsibility of the student to know them.

Academic fraud is an act committed by a student to distort the marking of assignments, tests, examinations, and other forms of academic evaluation. Academic fraud is neither accepted nor tolerated by the University. Anyone found guilty of academic fraud is liable to severe academic sanctions.

Here are a few examples of academic fraud:

- engaging in any form of plagiarism or cheating;
- presenting falsified research data;
- handing in an assignment that was not authored, in whole or in part, by the student;
- submitting the same assignment in more than one course, without the written consent of the professors concerned.

In recent years, the development of the Internet has made it much easier to identify academic plagiarism. The tools available to your professors allow them to trace the exact origin of a text on the Web, using just a few words.

For more information, refer to the Student's Guide to Academic Integrity and the Academic Integrity Website (Office of the Provost and Vice-President, Academic Affairs)