



## Course Outline

### Instructor

- Blair Yoshida, P.Eng.  
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(204) 480-1402  
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### Office Hours

- After lectures or by appointment

### Teaching Assistant

- Theja Muthukumarana Hewa  
Thondilege  
muthukut@myumanitoba.ca
- TBD

### Contact Hours

- 4 credit hours
- Lectures:  
3 hours x 13 weeks = 39 hours
- Laboratories:  
3 hours x 5 weeks = 15 hours

### Prerequisites:

- ECE 2160 Electronics 2E
- ECE 3780 Signal Processing 1

### Course Website:

<https://umanitoba.ca/umlearn>

## Traditional Territories Acknowledgement

The University of Manitoba campuses and the Department of Electrical and Computer Engineering are located on the original lands of the Anishinaabeg, Cree, Oji-Cree, Dakota, and Dene peoples, and on the homeland of the Métis Nation.

We respect the Treaties that were made on these territories, we acknowledge the harms and mistakes of the past, and we dedicate ourselves to move forward in partnership with Indigenous communities in a spirit of reconciliation and collaboration.

## ECE 4150 – Control Systems

Winter 2022

### IMPORTANT NOTICE

Lectures and laboratories in this course will initially be conducted via remote instruction but will return to *in-person instruction* the week of February 28<sup>th</sup> 2022. All students are required to be present for in-person instruction at that time. Furthermore, University policy requires all students to be fully vaccinated against COVID-19 in order to attend campus and participate in this course.

### Course Objectives

This course provides an introduction to modelling, analysis, and design of feedback control systems. This course not only focuses on mathematical concepts in continuous-time linear control systems, including Laplace Transforms, transfer functions and controller design, but also provides students with hands-on experience in the analysis and design of feedback control systems. After this course, students are expected to know how to analyze the performance of feedback control systems and design controllers to meet required system specifications.

### Course Content

The following topics will be covered:

- Introduction to control systems.
- Mathematical modelling of systems.
- Feedback control systems characteristics and performance.
- Stability of linear feedback systems.
- The root locus method.
- Frequency response methods, and stability in the frequency domain.
- Introduction to compensator design.

### Laboratories

Complete experimental data for all five laboratories must be recorded in a laboratory notebook. At the end of each experiment, the notebook must be signed by the Teaching Assistant.

### Textbook

*Modern Control Systems*, R. C. Dorf and R. H. Bishop, Pearson Prentice Hall, 13<sup>th</sup> edition, 2016.

### Learning Outcomes

- Ability to convert a feedback control system a mathematically description which can be manipulated.
- Ability to analyze a feedback control system to predict its behaviour.
- Ability to predict the stability of a feedback control system.
- Ability to design components of a feedback control system.

### Expected Competency Levels

Outcome	KB	PA	IN	DE	ET	IT	CS	PR	IE	EE	EP	LL
1	4	4	4				3					3
2	6	4	4	2	3		3					3
3	4	4	4	2	3		3					3
4	5	5	5	5	3							3

## Important Dates

- **Term Test**  
Monday, March 14<sup>th</sup>, 2022  
6:00PM – 8:00PM
- **Voluntary Withdrawal Deadline**  
April 25<sup>th</sup>, 2022
- **Louis Riel Day**  
February 21<sup>st</sup>, 2022  
No classes or examinations
- **Spring Break**  
February 22<sup>nd</sup> – 25<sup>th</sup>, 2022  
No classes or examinations
- **Good Friday**  
April 15<sup>th</sup>, 2022  
No classes or examinations

## Accreditation Details

### Accreditation Units

- Mathematics: 0%
- Natural Science: 0%
- Complementary Studies: 0%
- Engineering Science: 70%
- Engineering Design: 30%

### Graduate Attributes

KB: A knowledge base for engineering  
PA: Problem analysis  
IN: Investigation  
DE: Design  
ET: Use of engineering tools  
IT: Individual and team work  
CS: Communication skills  
PR: Professionalism  
IE: Impact of engineering on society/  
environment  
EE: Ethics and equity  
EP: Economics and project  
management  
LL: Life-long learning

### Competency Levels

- 1 - Knowledge (Able to recall information)
- 2 - Comprehension (Ability to rephrase information)
- 3 - Application (Ability to apply knowledge in a new situation)
- 4 - Analysis (Able to break problem into its components and establish relationships.)
- 5 - Synthesis (Able to combine separate elements into a whole)
- 6 - Evaluation (Able to judge the worth of something)

## Evaluation

The final course grade will be determined from a student's performance in laboratories, and on examinations. Programmable calculators are not allowed in the mid-term, and final examination. Students must receive a minimum of 50% on the final examination and must complete all the laboratories in order to be eligible to receive a passing grade.

Component	Value (%)	Method of Feedback	Learning Outcomes Evaluated
Quizzes	10	F, S	1, 2, 3, 4
Assignments	5	F, S	1, 2, 3, 4
Laboratories	10	F, S	1, 2, 3, 4
Term Test	25	F, S	1, 2, 3, 4
Final Examination	50	S	1, 2, 3, 4

\* Method of Feedback: F - Formative (written comments and/or oral discussion), S - summative (numerical grade)

## CEAB Graduate Attributes Assessed

KB.4 – Recalls and defines, and/or comprehends and applies, first principles and concepts in specialized engineering science.

IN.1 – Gathers information (literature review, measurements, experiments, laboratory exercises) and analyzes data.

## Academic Integrity

Students are expected to conduct themselves in accordance with the highest ethical standards of the Profession of Engineering and evince academic integrity in all their pursuits and activities at the university. As such, in accordance with the *General Academic Regulations* on *Academic Integrity*, students are reminded that plagiarism or any other form of cheating in examinations, term tests, assignments, projects, or laboratory reports is subject to serious academic penalty (e.g. suspension or expulsion from the faculty or university). A student found guilty of contributing to cheating by another student is also subject to serious academic penalty.

## Requirements and Regulations

- Attendance at lectures and laboratories is essential for successful completion of this course. Students must satisfy each evaluation component in the course to receive a passing final grade.
- It is the responsibility of each student to contact the instructor in a timely manner if he or she is uncertain about his or her standing in the course and about his or her potential for receiving a failing grade. Students should also familiarize themselves with the University's *General Academic Regulations*, as well as Section 3 of the Faculty of Engineering *Academic Regulations* dealing with incomplete term work, deferred examinations, attendance and withdrawal.
- No programmable devices or systems (such as calculators, PDAs, iPods, iPads, cell phones, wireless communication or data storage devices) are allowed in examinations unless approved by the course instructor.
- Students should be aware that they have access to an extensive range of resources and support organizations. These include Academic Resources, Counselling, Advocacy and Accessibility Offices as well as documentation of key University policies e.g. Academic Integrity, Respectful Behaviour, Examinations and related matters.

 [Supplemental Resources](#)

## Copyright Notice

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## Grading Scale

Letter	Mark
A+	95–100
A	85–94
B+	80–84
B	70–79
C+	65–69
C	55–64
D	45–54
F	< 45

Note: These boundaries represent a guide for the instructor and class alike. Provided that no individual student is disadvantaged, the instructor may vary any of these boundaries to ensure consistency of grading from year-to-year.

## Retention of Student Work

Students are advised that copies of their work submitted in completing course requirements (i.e. assignments, laboratory reports, project reports, test papers, examination papers, etc.) may be retained by the instructor and/or the department for the purpose of student assessment and grading, and to support the ongoing accreditation of each Engineering program. This material shall be handled in accordance with the University's *Intellectual Property Policy* and the protection of privacy provisions of *The Freedom of Information and Protection of Privacy Act (Manitoba)*. Students who do not wish to have their work retained must inform the Head of Department, in writing, at their earliest opportunity.