HUMBER

Course Outline

Course Name: Control Systems (Electrical Control Systems) (ELEC 350)

Academic Period: 2023 - 2024

Faculty:

Faculty Availability:

Associate Dean:
Shaun Ghafari
shaun.ghafari@humber.ca

Schedule Type Code:

Land Acknowledgement

Humber College is located within the traditional and treaty lands of the Mississaugas of the Credit. Known as Adoobiigok [A-doe-bee-goke], the "Place of the Alders" in Michi Saagiig [Mi-Chee Saw-Geeg] language, the region is uniquely situated along Humber River Watershed, which historically provided an integral connection for Anishinaabe [Ah-nish-nah-bay], Haudenosaunee [Hoeden-no-shownee], and Wendat [Wine-Dot] peoples between the Ontario Lakeshore and the Lake Simcoe/Georgian Bay regions. Now home to people of numerous nations, Adoobiigok continues to provide a vital source of interconnection for all.

Equity, Diversity and Inclusion Statement

Humber College and the University of Guelph-Humber (Humber) are leaders in providing a learning, working and living environment that recognizes and values equity, diversity and inclusion in all its programs and services. Humber commits to reflect the diversity of the communities the College serves. Students, faculty, support and administrative staff feel a sense of belonging and have opportunities to be their authentic selves.

Faculty or Department	Faculty of Applied Sciences & Technology
Course Name:	Control Systems (Electrical Control Systems) (ELEC 350)
Pre-Requisites	CALC 203 & ELEC 251
Co-Requisites	none
Equates	none
Restrictions	none
Credit Value	3
Total Course Hours	56

Developed By:	Prepared By:	Approved by:
		Shaun Ghafari

Humber Learning Outcomes (HLOs) in this course.

The HLOs are a cross-institutional learning outcomes strategy aimed at equipping Humber graduates with the employability skills, mindsets, and values they need to succeed in the future of work. To explore all the HLOs, please consult the Humber Learning Outcomes framework.

- Critical Thinking
- Digital Fluency
- Professionalism
- Strategic Problem-Solving

Course Description

This course familiarizes students with various process control schemes and methodologies. After a thorough review of basic differential equations and their solution using the Laplace transform, the modeling of physical systems is pursued methodically. This leads to the development of transfer functions, block diagrams and the concepts of feedback, sensitivity, stability, time and frequency response and transient response of systems. The course concludes with frequency-response and root-locus analysis and design. Simulation of systems is emphasized throughout the course. The laboratory component includes extensive use of MATLAB and SIMULINK.

Course Rationale

Analysis and synthesis of dynamic control systems, i.e. systems that perform control of desired variables such as temperature, pressure, level, position, speed, etc. is one of the major parts of the engineering. In this course, students are introduced to the classic methods and algorithms of the control based on the frequency response method.

Course Learning Method(s)

- Simulations
- Lecture

Learning Outcomes

- Contrast open loop and closed loop control systems
- Interpret the block diagram of a closed loop control system with its process and controlled variable, its sensor and measurement (feedback) signal, its controller and controller output signal
- Derive the integral-differential equations from physical model of the control system
- Perform the Laplace transformation of the time-domain equation to obtain the frequency-domain equation
- Operate the transfer function of a system components to obtain the gain and the phase shift at a specified frequency
- Estimate the overshoot, period, and settling time from the step response
- Determine the stability of closed-loop system using Nyquist stability criterion and the Bode diagram of open-loop control system
- Categorize different types of control and give an example of each
- Apply the root locus method of analysis and synthesis of control system

Assessment Weighting

Assessment	Weight
Final Exam	
Test#2	35%
In-class Exercise	
Lab assignment	30%
Midterm Exam	
Test#1	35%
Total	**100%**

Modules of Study

Module	Course Learning Outcomes	Resources	Assessments
Module 1: Basic Control Concepts and Terminology	• Contrast open loop and closed loop control systems • Interpret the block diagram of a closed loop control system with its process and controlled variable, its sensor and measurement (feedback) signal, its controller and controller output signal	Robert N. Bateson (2002). *Introduction to Control System Technology (7th Ed.).* Upper Saddle River, N.J.: Prentice-Hall. Lecture notes	• Test#1 • Lab assignment
Module 2: Common System Component Modeling	• Interpret the block diagram of a closed loop control system with its process and controlled variable, its sensor and measurement (feedback) signal, its controller and controller output signal • Derive the integral-differential equations from physical model of the control system	Robert N. Bateson (2002). *Introduction to Control System Technology (7th Ed.).* Upper Saddle River, N.J.: Prentice-Hall. Lecture notes	• Test#1 • Lab assignment
Module 3: Laplace Transforms and Transfer Functions	• Interpret the block diagram of a closed loop control system with its process and controlled variable, its sensor and measurement (feedback) signal, its controller and controller output signal • Perform the Laplace transformation of the time-domain equation to obtain the frequency-domain equation • Operate the transfer function of a system components to obtain the gain and the phase shift at a specified frequency	Robert N. Bateson (2002). *Introduction to Control System Technology (7th Ed.).* Upper Saddle River, N.J.: Prentice-Hall. Lecture notes	• Test#1 • Lab assignment

Module	Course Learning Outcomes	Resources	Assessments
Module 4: Measuring Instruments	• Operate the transfer function of a system components to obtain the gain and the phase shift at a specified frequency • Estimate the overshoot, period, and settling time from the step response • Categorize different types of control and give an example of each	Robert N. Bateson (2002). *Introduction to Control System Technology (7^{th} Ed.)*. Upper Saddle River, N.J.: Prentice-Hall. Lecture notes	• Lab assignment • Test#2
Module 5: Process Characteristics	• Operate the transfer function of a system components to obtain the gain and the phase shift at a specified frequency • Determine the stability of closed-loop system using Nyquist stability criterion and the Bode diagram of open-loop control system • Categorize different types of control and give an example of each	Robert N. Bateson (2002). *Introduction to Control System Technology (7^{th} Ed.)*. Upper Saddle River, N.J.: Prentice-Hall. Lecture notes	• Lab assignment • Test#2
Module 6: Control System Analysis	• Determine the stability of closed-loop system using Nyquist stability criterion and the Bode diagram of open-loop control system	Robert N. Bateson (2002). *Introduction to Control System Technology (7^{th} Ed.)*. Upper Saddle River, N.J.: Prentice-Hall. Lecture notes	• Lab assignment • Test#2
Module 7: Controller Design	• Apply the root locus method of analysis and synthesis of control system	Robert N. Bateson (2002). *Introduction to Control System Technology (7^{th} Ed.)*. Upper Saddle River, N.J.: Prentice-Hall. Lecture notes	• Lab assignment • Test#2

Required Resources

Robert N. Bateson (2002). *Introduction to Control System Technology (7^{th} Ed.)*. Upper Saddle River, N.J.: Prentice-Hall.

Supplemental Resources

Weedon, T.A., Kirk, Ph., Kirk, F.W. (2019). *Instrumentation and Process Control (7th Ed.)*. Orland Park, Illinois: American Technical Publishers.

Additional Tools and Equipment

- Not required

Essential Skills

Section	Skills	Measurement	Details
Communication	• Reading • Writing • Speaking • Presenting • Visual Literacy	Teach and measure	• Through lecturing and practical activities in the laboratory • Through lab assignment and tests
Numeracy	• Understanding and applying mathematical concepts and reasoning • Analyzing and using numerical data • Conceptualizing	Teach and measure	• Through lecturing, lab activities, discussions, case studies • Through lab assignments and tests
Critical Thinking and Problem-Solving	• Analysing • Synthesizing • Evaluating • Decision-Making	Teach and measure	• Through lecturing, lab activities, discussions • Through lab assignments and tests
Information Management	• Gathering and managing information • Selecting and using appropriate tools and technology for a task or project • Computer literacy	Teach and measure	• Through lecturing and lab activities • Through lab assignments and tests
Interpersonal Skills	• Teamwork • Conflict resolution • Networking	Reinforce and measure	• Through lab activities • Through lab assignments
Personal Skills	• Managing self • Managing change and being flexible and adaptable • Demonstrating personal responsibility	Reinforce and measure	• Through lab activities • Through lab assignments

Prior Learning Assessment & Recognition (PLAR)

Prior Learning Assessment and Recognition (PLAR) is the formal evaluation and credit-granting process whereby candidates may obtain credits for prior learning. Prior learning includes the knowledge competencies and skills acquired, in both formal and informal ways, outside of post-secondary education. Candidates may have their knowledge, skills and competencies evaluated against the learning outcomes as defined in the course outline. Please review the Assessment Methods Glossary for more information on the Learning Portfolio assessment methods identified below.

The method(s) that are used to assess prior learning for this course may include:

- Challenge Exam (results recorded as a % grade and added to student's CGPA)
- Learning Portfolio (results reflected as SAT and not added to student's CGPA)

- Skills Test

Please contact the Program Coordinator for more details.

Academic Regulations

It is the student's responsibility to be aware of the College Academic Regulations. The Academic Regulations apply to all applicants to Humber and all current students enrolled in any program or course offered by Humber, in any location. Information about academic appeals is found in the **Academic Regulations**.

Anti-Discrimination Statement

At Humber College, all forms of discrimination and harassment are prohibited. Students and employees have the right to study, live and work in an environment that is free from discrimination and harassment. If you need assistance on concerns related to discrimination and harassment, please contact the Centre for Human Rights, Equity and Inclusion or the Office of Student Conduct.

Accessible Learning Services

Humber strives to create a welcoming environment for all students where equity, diversity and inclusion are paramount. Accessible Learning Services facilitates equal access for students with disabilities by coordinating academic accommodations and services. Staff in Accessible Learning Services are available by appointment to assess specific needs, provide referrals and arrange appropriate accommodations. If you require academic accommodations, contact:

Accessible Learning Services

North Campus: (416) 675-6622 X5090

Lakeshore Campus: (416) 675-6622 X3331

Academic Integrity

Academic integrity is essentially honesty in all academic endeavors. Academic integrity requires that students avoid all forms of academic misconduct or dishonesty, including plagiarism, cheating on tests or exams or any misrepresentation of academic accomplishment.

Disclaimer

While every effort is made by the professor/faculty to cover all material listed in the outline, the order, content, and/or evaluation may change in the event of special circumstances (e.g. time constraints due to inclement weather, sickness, college closure, technology/equipment problems or changes, etc.). In any such case, students will be given appropriate notification in writing, with approval from the Dean (or designate) of the School.

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See the **Humber Libraries website** for additional information regarding copyright and for details on allowable limits.
