



Course Outline

Course Name: Automatic Controls: Introduction (ELEC 251)

Academic Period: 2023 - 2024

Faculty:

Faculty Availability:

Associate Dean:

Shaun Ghafari
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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:	Automatic Controls: Introduction (ELEC 251)
Pre-Requisites	CALC 103
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

Course Description

This course provides the students with a working knowledge of process control terminology and concepts of system modeling and block diagrams. They learn the interaction between the process signal transmitter, final control element, controller, and the "Process". They learn the principles of the open and closed loop control as well as all controller modes namely: ON-OFF, differential, proportional, integral, and derivative. Students apply standard controller tuning methods as well as PLC PID control functions and their parameter settings for different controller models.

Course Rationale

This course introduces students to the methods of automatic control of industrial systems. Detailed study of Proportional-Integral-Derivative (PID) control algorithm and its components will be accompanied by controller tuning methods.

Course Learning Method(s)

- Problem Based Learning (PBL)
- Lecture

Learning Outcomes

- Explain the concept of feedback in automatic control systems by using a block diagram representation.
- Select the proper control mode for any particular control task based on the desired performance and criteria.
- Evaluate the control system parameters and component characteristics to analyze the control system loop.
- Perform calculation of proportional offset and justifying the implementation of integral (or reset) and derivative control actions as the controller modes.
- Analyze the PID controlled system's response by using the PLC trends.
- Apply the right PID tuning method to particular application based on the desired performance and criteria.
- Adjust the parameters of the PID block function of PLCs for variety of applications based on the PID controller tuning criteria.

Assessment Weighting

Assessment	Weight
Final Exam	
Test 2	30%

Assessment	Weight
Demonstration	
Labs- In process evaluation	30%
Quiz	
Quizzes	15%
Midterm Exam	
Test 1	25%
Total	100%

Modules of Study

Module	Course Learning Outcomes	Resources	Assessments
Introduction to Process Control, and Principle of Negative Feedback	<ul style="list-style-type: none"> Explain the concept of feedback in automatic control systems by using a block diagram representation. Evaluate the control system parameters and component characteristics to analyze the control system loop. 	<ul style="list-style-type: none"> Textbook (Chapter 35) Lecture Notes 	<ul style="list-style-type: none"> Test 1 Quizzes Labs- In process evaluation
Control Strategies: ON-OFF Control, Time-Proportional ON-OFF Control	<ul style="list-style-type: none"> Select the proper control mode for any particular control task based on the desired performance and criteria. Evaluate the control system parameters and component characteristics to analyze the control system loop. 	<ul style="list-style-type: none"> Textbook (Chapter 36) Lecture Notes 	<ul style="list-style-type: none"> Test 1 Quizzes Labs- In process evaluation
Control Strategies: Proportional Control	<ul style="list-style-type: none"> Select the proper control mode for any particular control task based on the desired performance and criteria. Evaluate the control system parameters and component characteristics to analyze the control system loop. Perform calculation of proportional offset and justifying the implementation of integral (or reset) and derivative control actions as the controller modes. 	<ul style="list-style-type: none"> Textbook (Chapter 36) Lecture Notes 	<ul style="list-style-type: none"> Test 1 Quizzes Labs- In process evaluation

Module	Course Learning Outcomes	Resources	Assessments
Control Strategies: Integral Control	<ul style="list-style-type: none"> Select the proper control mode for any particular control task based on the desired performance and criteria. Evaluate the control system parameters and component characteristics to analyze the control system loop. Perform calculation of proportional offset and justifying the implementation of integral (or reset) and derivative control actions as the controller modes. 	<ul style="list-style-type: none"> Textbook (Chapter 36) Lecture Notes 	<ul style="list-style-type: none"> Test 2 Quizzes Labs- In process evaluation
Control Strategies: Derivative Control	<ul style="list-style-type: none"> Select the proper control mode for any particular control task based on the desired performance and criteria. Evaluate the control system parameters and component characteristics to analyze the control system loop. Perform calculation of proportional offset and justifying the implementation of integral (or reset) and derivative control actions as the controller modes. 	<ul style="list-style-type: none"> Textbook (Chapter 36) Lecture Notes 	<ul style="list-style-type: none"> Test 2 Quizzes Labs- In process evaluation
Controller Tuning Methods	<ul style="list-style-type: none"> Select the proper control mode for any particular control task based on the desired performance and criteria. Apply the right PID tuning method to particular application based on the desired performance and criteria. Adjust the parameters of the PID block function of PLCs for variety of applications based on the PID controller tuning criteria. 	<ul style="list-style-type: none"> Textbook (Chapter 37) Lecture Notes 	<ul style="list-style-type: none"> Test 2 Quizzes Labs- In process evaluation
PLC PID Blocks and Parameter Tuning	<ul style="list-style-type: none"> Analyze the PID controlled system's response by using the PLC trends. Apply the right PID tuning method to particular application based on the desired performance and criteria. Adjust the parameters of the PID block function of PLCs for variety of applications based on the PID controller tuning criteria. 	<ul style="list-style-type: none"> RS-Logic 500 Programmer Manual Lecture Notes 	<ul style="list-style-type: none"> Test 2 Quizzes Labs- In process evaluation

Required Resources

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

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

Supplemental Resources

Manufacturer's documentation, manuals, and user guides for Allen-Bradley PLCs.

https://literature.rockwellautomation.com/idc/groups/literature/documents/rm/1747-rm001_-en-p.pdf

https://literature.rockwellautomation.com/idc/groups/literature/documents/sg/1747-sg001_-en-p.pdf

https://literature.rockwellautomation.com/idc/groups/literature/documents/gr/lg500-gr002_-en-e.pdf

Essential Skills

Section	Skills	Measurement	Details
Communication	<ul style="list-style-type: none"> • Reading • Writing • Speaking • Listening • Presenting 	Reinforce and measure	<ul style="list-style-type: none"> • Communicate clearly, concisely, and correctly in the written, spoken, and visual form that fulfills the purpose and meets the needs of the audience. Respond to written, spoken, or visual messages in a manner that ensures effective communication. • A combination of summative and formative assessments, such as tests, quizzes, and lab reports has been applied to evaluate the learners.
Numeracy	<ul style="list-style-type: none"> • Understanding and applying mathematical concepts and reasoning • Analyzing and using numerical data • Conceptualizing 	Teach and measure	<ul style="list-style-type: none"> • Execute mathematical operations accurately. • A combination of summative and formative assessments, such as tests, quizzes, and lab reports has been applied to evaluate the learners.
Critical Thinking and Problem-Solving	<ul style="list-style-type: none"> • Analysing • Evaluating • Decision-Making 	Reinforce and measure	<ul style="list-style-type: none"> • Apply a systematic approach to solve problems. Use a variety of thinking skills to anticipate and solve problems. • A combination of summative and formative assessments, such as tests, quizzes, and lab reports has been applied to evaluate the learners.

Section	Skills	Measurement	Details
Information Management	<ul style="list-style-type: none"> Gathering and managing information Selecting and using appropriate tools and technology for a task or project Computer literacy 	Reinforce and measure	<ul style="list-style-type: none"> Locate, select, organize, and document information using appropriate technology and information systems. Analyze, evaluate, and apply relevant information from a variety of sources. A combination of summative and formative assessments, such as tests, quizzes, and lab reports has been applied to evaluate the learners.
Interpersonal Skills	<ul style="list-style-type: none"> Teamwork Relationship management 	Reinforce and measure	<ul style="list-style-type: none"> Show respect for diverse opinions, values belief systems, and contributions of others. Interact with others in groups or teams in ways that contribute to effective working relationships and the achievement of goals. A combination of summative and formative assessments, such as tests, quizzes, and lab reports has been applied to evaluate the learners.
Personal Skills	<ul style="list-style-type: none"> Managing self Managing change and being flexible and adaptable Engaging in reflective practice Demonstrating personal responsibility 	Reinforce and measure	<ul style="list-style-type: none"> Manage the use of time and other resources to complete projects. Take responsibility for one's own actions, decisions, and consequences. A combination of summative and formative assessments, such as tests, quizzes, and lab reports has been applied to evaluate the learners.

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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