ECE 4160 - Control Engineering  
Winter 2020

Course Objectives

Design of control systems by frequency domain and root locus method; state equations; introduction to nonlinear analysis.

This course provides a continuation of material presented in Control Systems, and introduces non-LTI systems, and an introduction to the analysis and design of computer-controlled systems. This course not only focuses on mathematical concepts in digital control, including transfer functions, state space models, Z-transform, and digital controller design, but also provides students with hands-on experience in analysis and design of digital control systems using simulation software. After this course, students are expected to know how to analyze the performance of digital control systems and design feedback controllers to meet required system performance specifications.

Course Content

The following topics will be covered:

- Introduction to transfer functions and state-space system representation.
- Introduction to non LTI systems.
- Introduction to digital control systems.
- Discrete systems analysis.
- Sampled data systems.
- Discrete system analysis using z-transform and inverse z-transform.
- Discrete equivalents to continuous systems.
- Design using transform techniques.
- Effects of sampling and quantization.

Textbook


Learning Outcomes

1. Ability to implement a feedback control system based on a mathematical description.
2. Ability to analyze a digital control system.
3. Ability to design, for implementation, specific control systems.

Expected Competency Levels

<table>
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<tr>
<th>Outcome</th>
<th>KB</th>
<th>PA</th>
<th>IN</th>
<th>DE</th>
<th>ET</th>
<th>IT</th>
<th>CS</th>
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CEAB Graduate Attributes Assessed

PA.3 – Analyzes and solves complex engineering problems.
DE.3 – Develops/implements possible solutions to an open-ended design problem, leading to an appropriate recommendation.
Evaluation

The final course grade will be determined from a student's performance in laboratories, assignments, 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.

<table>
<thead>
<tr>
<th>Component</th>
<th>Value (%)</th>
<th>Method of Feedback</th>
<th>Learning Outcomes Evaluated</th>
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</thead>
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<tr>
<td>Quizzes</td>
<td>10</td>
<td>F, S</td>
<td>1, 2, 3</td>
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<tr>
<td>Assignments</td>
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<td>F, S</td>
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<td>Laboratories</td>
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<td>1, 2, 3</td>
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<tr>
<td>Final Examination</td>
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<td>S</td>
<td>1, 2, 3</td>
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</table>

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

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/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 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, smart watches, 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.

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.

Supplemental Information

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