The Hong Kong University of Science and Technology

UG Course Syllabus

System Modeling, Analysis and Control

ELEC3200

4 Credits

Prerequisites: (ELEC 2100 OR ELEC 2100H) AND [MATH 2350 OR (MATH 2111 AND MATH 2351)]

Exclusions: CENG 4120, MECH 3610

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Course Description

This course introduces basic concepts, tools and techniques for modeling, analysis, and control of dynamical systems. The course starts from the use of differential equations to model continuous time systems. Examples from a variety of Electronic and Computer Engineering disciplines will be given to illustrate the modeling process. Then, basic tools needed for analyzing the behavior of dynamical systems will be presented. Finally, techniques for controlling their behavior will be introduced. Throughout the course, laboratory experiments demonstrating the use of these analysis/design tools will be included.

Intended Learning Outcomes (ILOs)

By the end of this course, students should be able to:

ILO1 - model simple dynamical systems using differential equations as well as understand the importance of the models in system analysis, synthesis, and simulation.

ILO2 - manipulate the models of LTI systems in different forms, such as differential equations, transfer functions, and block diagrams, analytically and by CAD tools (such as MATLAB).

ILO3 - understand feedback as a ubiquitous tool to control a system

ILO4 - understand the importance of stability in a physical system and understand how to achieve stability using feedback control.

ILO5 - complete a real feedback control task from modeling, controller design, simulation, and implementation using CAD tools (such as MATLAB).

ILO6 - understand the robustness and performance issues in a control system and the ways to address these issues

Assessment and Grading

This course will be assessed using criterion-referencing and grades will not be assigned using a curve. Detailed rubrics for each assignment are provided below, outlining the criteria used for evaluation.

Assessments:

[List specific assessed tasks, exams, quizzes, their weightage, and due dates; perhaps, add a summary table as below, to precede the details for each assessment.]

Assessment Task	Contribution to Overall Course grade (%)	Due date
Homework	20%	Week 4, 7, 10, 13
Laboratory	2% (bonus)	Week 10, 12
Mid-Term Examination	30%	Week 8
Final Examination	50%	Dec final exam period, 2026

* Assessment marks for individual assessed tasks will be released within two weeks of the due date.

Mapping of Course ILOs to Assessment Tasks

Assessed Task	Mapped ILOs	Explanation
Homework assignment	ILO1, ILO2, ILO3, ILO4, ILO6	This task assesses students' ability to model simple dynamical systems (ILO 1), manipulate the models of LTI systems in different forms (ILO 2), understand feedback as a ubiquitous tool to control a system (ILO 3), understand the importance of stability in a physical system and how to achieve stability (ILO 4) and understand the robustness and performance issues in a control system and the ways to address these issues (ILO 6).
Laboratory experiments	ILO1, ILO3, ILO4, ILO5	This task assesses students' ability to model simple dynamical systems (ILO 1), understand feedback as a ubiquitous tool to control a system (ILO 3), understand the importance of stability in a physical system and how to achieve stability (ILO 4) and complete a real feedback control task from modeling, controller design, simulation, and implementation using CAD tools (ILO 5).
Mid-term, and Final exam	ILO1, ILO2, ILO3, ILO4, ILO6	The exam assesses students' ability to model simple dynamical systems (ILO 1), manipulate the models of LTI systems in different forms (ILO 2), understand feedback as a ubiquitous tool to control a system (ILO 3), understand the importance of stability in a physical system and how to

		achieve stability (ILO 4) and understand the robustness and performance issues in a control system and the ways to address these issues (ILO 6).

Grading Rubrics

Homework, Mid-term, Final Exam Rubric:

	4	3	2	1	0
Knowledge	Exemplary work. No mistakes. Excellent understanding.	Adequate level of work. A few minor mistakes. Good level of understanding.	Minimum acceptable work. Many minor mistakes. Some understanding.	Some correct. Has major mistakes. Limited understanding.	All Wrong
Calculation Skills	Exemplary work. No mistakes. Excellent understanding.	Adequate level of work. A few minor mistakes. Good level of understanding.	Minimum acceptable work. Many minor mistakes. Some understanding.	Some correct. Has major mistakes. Limited understanding.	All Wrong
Analysis	Exemplary work. No mistakes. Excellent understanding.	Adequate level of work. A few minor mistakes. Good level of understanding.	Minimum acceptable work. Many minor mistakes. Some understanding.	Some correct. Has major mistakes. Limited understanding.	All Wrong

Lab Experiment Rubric:

	Pass	Fail
Experiment results	Successfully complete the experiment.	Fail to complete the experiment.

Final Grade Descriptors:

Grades	**Short Description**	**Elaboration on subject grading description**
A	Excellent Performance	Demonstrates a comprehensive grasp of subject matter, expertise in problem-solving, and significant creativity in thinking. Exhibits a high capacity for scholarship and collaboration, going beyond core requirements to achieve learning goals.
B	Good Performance	Shows good knowledge and understanding of the main subject matter, competence in problem-solving, and the ability to analyze

		and evaluate issues. Displays high motivation to learn and the ability to work effectively with others.
C	Satisfactory Performance	Possesses adequate knowledge of core subject matter, competence in dealing with familiar problems, and some capacity for analysis and critical thinking. Shows persistence and effort to achieve broadly defined learning goals.
D	Marginal Pass	Has threshold knowledge of core subject matter, potential to achieve key professional skills, and the ability to make basic judgments. Benefits from the course and has the potential to develop in the discipline.
F	Fail	Demonstrates insufficient understanding of the subject matter and lacks the necessary problem-solving skills. Shows limited ability to think critically or analytically and exhibits minimal effort towards achieving learning goals. Does not meet the threshold requirements for professional practice or development in the discipline.

Course AI Policy

The use of Generative AI in homework and labs is permitted with proper acknowledgement and will NOT be allowed during mid-term or final exams which are closed-book exams.

Communication and Feedback

- Homework assessment marks will be provided via Canvas within two weeks of submission.
- Laboratory assignment feedback will be given during the demonstration to the marker.
- Students seeking clarification or further feedback, including marks, should consult the instructor/teaching team within one week of receiving the feedback or as specified in the email.

Resubmission Policy

To ensure fairness for students who submit assignments on time, a penalty for late submission is listed as follows:

- Late submission within 12 hours, 25% penalty will be applied.
- Late submission between 12 to 24 hours, 50% penalty will be applied.
- Late submission for more than 24 hours will not be accepted.

Required Texts and Materials

Textbook:

L. Qiu and K. Zhou, *Introduction to Feedback Control*, Prentice Hall, 2009.

Additional Resources:

K. J. Åström and R. M. Murray, *Feedback System: an introduction for scientists and engineers*, Prentice Hall, 2011.

Academic Integrity

Students are expected to adhere to the university's academic integrity policy. Students are expected to uphold HKUST's Academic Honor Code and to maintain the highest standards of academic integrity. The University has zero tolerance of academic misconduct. Please refer to Academic Integrity | HKUST – Academic Registry for the University's definition of plagiarism and ways to avoid cheating and plagiarism.