City University of Hong Kong
Course Syllabus

offered by
Department of Biomedical Engineering
with effect from Semester A 2024/25

Part I Course Overview

Course Title:	Advanced Control Systems
Course Code:	BME6114
Course Duration:	1 semester
Credit Units:	3 credits
Level:	P6
Medium of Instruction:	English
Medium of Assessment:	English
Prerequisites : *(Course Code and Title)*	Nil
Precursors: *(Course Code and Title)*	BME3105 Biomedical Systems and Control or MBE3049/MNE3049 Control Principles or Equivalent course on Control Principles or Theory
Equivalent Courses: *(Course Code and Title)*	MBE6114 / MNE6114 Control Systems and Information Processing/BME8128 Advanced Control Systems
Exclusive Courses: *(Course Code and Title)*	Nil

Part II Course Details

1. Abstract

The aim of this course is to introduce the fundamental concepts, principles design and application of advanced control systems. The course begins with a review of linear time-invariant systems modelling. State space analysis and design will then be introduced, mainly for continuous time systems and also briefly for discrete time systems. Stability analysis and some related feedback control design tools will be covered. Topics in advanced control systems such as nonlinear system control, adaptive control, or optimal control will also be briefly introduced. The content is mathematically oriented with illustrative examples from general engineering systems. This course does require an understanding of undergraduate calculus, differential equations and linear algebra.

2. Course Intended Learning Outcomes (CILOs)

(CILOs state what the student is expected to be able to do at the end of the course according to a given standard of performance.)

No.	CILOs	Weighting (if applicable)	Discovery-enriched curriculum related learning outcomes (please tick where appropriate)		
			A1	*A2*	*A3*
1.	Comprehend fundamental concepts of systems and control.			✓	
2.	Analyse a given system using state space methods.			✓	
3.	Design feedback control laws for engineering systems.			✓	
4.	Apply advanced control theory to practical engineering problems.			✓	✓
		N.A.			

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

3. Learning and Teaching Activities (LTAs)

(LTAs designed to facilitate students' achievement of the CILOs.)

LTA	Brief Description	CILO No.				Hours/week (if applicable)
		1	2	3	4	
Lecture	Weekly lectures	✓	✓	✓	✓	2 hrs/ week
Tutorial	Case studies and practice / demonstration of solving problems	✓	✓	✓	✓	1 hr/week

4. Assessment Tasks/Activities (ATs)

(ATs are designed to assess how well the students achieve the CILOs.)

Assessment Tasks/Activities	CILO No.				Weighting	Remarks
	1	2	3	4		
Continuous Assessment: 50%						
Assignments	✓	✓	✓	✓	25%	
Test	✓	✓	✓		25%	
Examination: 50%						
Examination	✓	✓	✓		50%	Duration: 2 hours
					100%	

For a student to pass the course, at least 30% of the maximum mark for both coursework and examination should be obtained.

5. Assessment Rubrics

(Grading of student achievements is based on student performance in assessment tasks/activities with the following rubrics.)

Applicable to students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1. Assignments	Ability to model and analyse linear and nonlinear systems, and to design appropriate control laws for engineering systems; Ability to explain the methodology and procedure in detail.	High	Significant	Moderate	Basic	Not even reaching marginal levels
2. Test	Ability to solve questions in advanced control theory.	High	Significant	Moderate	Basic	Not even reaching marginal levels
3. Examination	Ability to model, analyse and control simplified engineering systems.	High	Significant	Moderate	Basic	Not even reaching marginal levels

Applicable to students admitted from Semester A 2022/23 to Summer Term 2024

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B)	Marginal (B-, C+, C,)	Failure (F)
1. Assignments	Ability to model and analyse linear and nonlinear systems, and to design appropriate control laws for engineering systems; Ability to explain the methodology and procedure in detail.	High	Significant	Basic	Not even reaching marginal levels
2. Test	Ability to solve questions in advanced control theory.	High	Significant	Basic	Not even reaching marginal levels
3. Examination	Ability to model, analyse and control simplified engineering systems.	High	Significant	Basic	Not even reaching marginal levels

Part III Other Information (more details can be provided separately in the teaching plan)

1. Keyword Syllabus

(An indication of the key topics of the course.)

Linear system, , state variable, state space model, stability, controllability, observability, differential equation, difference equation, feedback control, observer, nonlinear systems, nonlinear control, adaptive control, optimal control

2. Reading List

2.1 Compulsory Readings

(Compulsory readings can include books, book chapters, or journal/magazine articles. There are also collections of e-books, e-journals available from the CityU Library.)

2.2 Additional Readings

(Additional references for students to learn to expand their knowledge about the subject.)

1.	Control Systems Engineering, Norman S. Nise, 7th Edition, John Wiley & Sons, Inc.
2.	Modern Control Engineering, Katsuhiko Ogata, Prentice Hall, 2010
3.	Applied Nonlinear Control, Jean-Jacques Slotine, Weiping Li, Prentice Hall, 1991
4.	Nonlinear Systems, Hassan K. Khalil, Prentice Hall, 2002, third edition