

**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:	<u>Advanced Control Systems</u>
Course Code:	<u>BME8128</u>
Course Duration:	<u>1 semester</u>
Credit Units:	<u>3 credits</u>
Level:	<u>R8</u>
Medium of Instruction:	<u>English</u>
Medium of Assessment:	<u>English</u>
Prerequisites : <i>(Course Code and Title)</i>	<u>Nil</u>
Precursors: <i>(Course Code and Title)</i>	<u>BME3105 Biomedical Systems and Control or MBE3049/MNE3049 Control Principles or Equivalent course on Control Principles or Theory</u>
Equivalent Courses: <i>(Course Code and Title)</i>	<u>MBE6114 Control Systems and Information Processing or BME6114 Advanced Control Systems</u>
Exclusive Courses: <i>(Course Code and Title)</i>	<u>Nil</u>

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)

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 self-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)

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)

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

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

1. Keyword Syllabus

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

2.2 Additional Readings

1.	Control Systems Engineering, Norman S. Nise, 7 th 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