City University of Hong Kong
Course Syllabus

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

Part I Course Overview

Course Title:	Control Systems and Information Processing
Course Code:	MNE6114
Course Duration:	1 semester
Credit Units:	3 credits
Level:	P6
Medium of Instruction:	English
Medium of Assessment:	English
Prerequisites: *(Course Code and Title)*	MNE3049 Control Principles or Equivalent course on Control Principles or Theory
Precursors: *(Course Code and Title)*	BME4032/MNE4032 Robotics & Machine Vision
Equivalent Courses: *(Course Code and Title)*	BME6114 Advanced Control Systems
Exclusive Courses: *(Course Code and Title)*	Nil

Part II Course Details

1. Abstract

The aim of this course is to introduce principles of control systems, their design, modern perception and advanced information processing. The emphasis will be placed on:

- The theory of control system and engineering;
- Modern information processing and perception, including application of machine learning in modern control system and robotics;
- System integration of dynamic control system;
- The performance evaluation, programming and application of robotics systems;
- The development, anticipation, model selection and supervision of control systems.

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.	Inspire the interest of students in primary technical components in control systems and information processing.		✓		
2.	Generate a number of competing alternatives that may form fixed, programmable or flexible control systems and then hypothesise performance of implementing each of them to select the most promising alternative.			✓	
3.	Analyse possible partitioning of a control system into functional modules. Appraise how information processing techniques can benefit each module.			✓	
4.	Develop a prototype system by fusing control systems and information processing.			✓	✓
		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: 60 %						
Assignments	✓	✓	✓		20%	2 times
Test	✓	✓	✓		15%	
Project (group)		✓	✓	✓	25%	
Examination: 40 % (duration: 2 hours)						
Examination	✓	✓	✓		40%	
					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	Capacity to solve theoretical questions and indication of mastering basic knowledge ranged in control theory, control engineering, machine learning, computer vision and robotics.	High	Significant	Moderate	Basic	Not even reaching marginal levels
2. Test	Ability to solve questions in control theory, control engineering, machine learning, robotics and computer vision.	High	Significant	Moderate	Basic	Not even reaching marginal levels
3. Project	Capacity to implement a particular system in simulated practice involving real equipment to accomplish an assumed task.	High	Significant	Moderate	Basic	Not even reaching marginal levels
4. Examination	Ability to solve questions in control theory, control engineering, machine learning, robotics and computer vision. Clear representation of the results and the process of solving the questions.	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	Capacity to solve theoretical questions and indication of mastering basic knowledge ranged in control theory, control engineering, machine learning, computer vision and robotics.	High	Significant	Moderate	Not even reaching marginal levels
2. Test	Ability to solve questions in control theory, control engineering, machine learning, robotics and computer vision.	High	Significant	Moderate	Not even reaching marginal levels
3. Project	Capacity to implement a particular system in simulated practice involving real equipment to accomplish an assumed task.	High	Significant	Moderate	Not even reaching marginal levels
4. Examination	Ability to solve questions in control theory, control engineering, machine learning, robotics and computer vision. Clear representation of the results and the process of solving the questions.	High	Significant	Moderate	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.)

- Control Principles: Feedback Control System, Stability, Controllability, Observability, System Modelling, Convergence, etc.
- Machine Learning: Bayesian Reasoning, Parametric Learning, Non-parametric Learning, Supervised/un-supervised Learning, Neural Network, Boosting, Regression, SVM, etc.
- Sensors and Information Processing: Laser Range Finder, Vision, Visible Light Communication, Iterative Closest Point, Normal Distributions Transform, Data Compression, Bayesian Data-fusion, Middleware System, Robotics Operation System, etc.
- Computer Vision: Calibration, Multi-view Geometry, etc.
- Robotics: SLAM, Localization, UAV, UGV, etc.

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.)

1.	*Modern Control Engineering,* Katsuhiko Ogata, Prentice Hall, 2010.
2.	*Bayesian reasoning and machine learning*. Barber, David. Cambridge University Press, 2012.

2.2 Additional Readings

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

1.	*Introduction to autonomous mobile robots*. Siegwart, Roland, Illah Reza Nourbakhsh, and Davide Scaramuzza. MIT press, 2011.
2.	*Pattern Recognition and Machine Learning (Information Science and Statistics*), C. Bishop, 2nd printing edition. 2007.
3.	*Robotics, vision and control: fundamental algorithms in MATLAB*. Corke, Peter. Springer, 2011.