

**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:	<u>Modern Robotics</u>
Course Code:	<u>MNE6130</u>
Course Duration:	<u>1 semester</u>
Credit Units:	<u>3 credits</u>
Level:	<u>P6</u>
Medium of Instruction:	<u>English</u>
Medium of Assessment:	<u>English</u>
Prerequisites: <i>(Course Code and Title)</i>	<u>Multivariable calculus, linear algebra, basic differential equations</u>
Precursors: <i>(Course Code and Title)</i>	<u>MNE6007 Advanced Automation Technology</u>
Equivalent Courses: <i>(Course Code and Title)</i>	<u>Nil</u>
Exclusive Courses: <i>(Course Code and Title)</i>	<u>Nil</u>

Part II Course Details

1. Abstract

Robotics is a rapidly growing field with increasing applications in domestic, service as well as industrial environment. This course provides an in-depth study on robotics at postgraduate level. The course covers the fundamental concepts and methods to analyse, model, and control of robotic systems. The topics to cover include robot kinematics, inverse kinematics, dynamics, motion control and planning, human-robot interactions, robot sensors and vision, robot programming and applications. Students will be involved in robot programming projects to reinforce the basic principles introduced in lectures. The course will also expose students to the advanced applications and latest developments in service robots as well as industrial robots.

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.	Describe the basic concepts, classifications, and practical applications of robotic systems.		✓		
2.	Explain the principles of robot kinematics, dynamics, motion planning and control, robotic sensing and programming.		✓	✓	
3.	Identify the needs for suitable robots for domestic, service and industrial applications.			✓	
4.	Apply the concepts, principles, and methods learned for the design and development of robots for different applications.			✓	✓
		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	To take place in the classroom. The main teaching activities will be in the form of lectures, which will be given related to the topics in the keyword syllabus.	✓	✓	✓	✓	2 hrs/week
Tutorial	To take place in the classroom. The tutorials are problem-solving and Q&A sessions for strengthening students' understanding of the contents of the lectures. The course project will also help in the learning practice.	✓	✓	✓	✓	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%						
Test/Assignments	✓	✓			10%	
Mini-projects			✓	✓	40%	
Examination: 50% (duration: 2 hours)						
Examination	✓	✓			50%	
					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. Test/Assignments	Ability to understand basic concepts related to microfluidics.	75%-100%	60%-74%	45%-59%	40%-44%	<40%
2. Mini-projects	Ability to explain in detail and apply the learned knowledge to the analysis and design of systems using microfluidic components for scientific research and practical applications.	Strong evidence of critical thinking; good capacity to analyze; superior grasp of subject matter; evidence of extensive knowledge of the project concerned.	Evidence of grasp of subject matter, some evidence of critical thinking and analysis; reasonable understanding of concepts; ability to develop the project.	Student who is profiting from the project; understanding of the subject matter; evidence of familiarity with the project.	Basic familiarity with the subject matter to enable the student to use knowledge in the project.	Little evidence of familiarity with the subject matter to accomplish the project.
3. Examination	Ability to understand the key concepts, principles, methods, and applications of microfluidic systems used in both scientific research and real-world products.	75%-100%	60%-74%	45%-59%	40%-44%	<40%

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

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. Test/Assignments	Ability to understand the basic concepts related to robotics.	75%-100%	65%-74%	50%-64%	<50%
2. Mini-projects	Ability to understand and explain in details and apply the learned knowledge to the analysis and design of robotic systems for practical applications.	Evidence of grasp of subject matter; evidence of critical thinking and analysis; reasonable understanding of concepts; ability to develop the project.	Student who is profiting from the project; understanding of the subject matter; evidence of familiarity with the project.	Basic familiarity with the subject matter to enable the student to use knowledge in the project.	Little evidence of familiarity with the subject matter to accomplish the project.
3. Examination	Ability of in-depth understanding of the key concepts, principles, methods, and applications of robotic systems.	75%-100%	65%-74%	50%-64%	<50%

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

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.)

Robot kinematics, inverse kinematics, dynamics, robot control, robot sensing and vision, motion planning, robot programming.

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.	"Robotics, Vision and Control: Fundamental Algorithms", 2nd Ed., Peter Corke, Springer, 2017.
2.	"Modern Robotics: Mechanics, Planning, and Control", Kevin M. Lynch and Frank C. Park, Cambridge University Press, 2017.
3.	"The Robotics Primer", Maja Mataric. MIT Press, 2007.
4.	"Robotics Modelling, Planning and Control", Bruno Siciliano, Lorenzo Sciavicco, Luigi Villani, Giuseppe Oriolo, Springer, 2009.

2.2 Additional Readings

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

1.	"Robot modeling and control", Spong, Mark W., Hutchinson Seth, Vidsayar M., Wiley, 2007.
2.	"Principles of Robot Motion: Theory, Algorithms, and Implementations", Howie Choset, Kevin M. Lynch, Seth Hutchinson, George A. Kantor, Wolfram Burgard, Lydia E. Kavraki and Sebastian Thrun, MIT Press, 2005.

Students are encouraged to find out related publications to widen their knowledge in the subjects.