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:	Advanced Micro/Nano Robotics
Course Code:	MNE6124
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)*	Nil
Equivalent Courses: *(Course Code and Title)*	Nil
Exclusive Courses: *(Course Code and Title)*	Nil

Part II Course Details

1. Abstract

Micro and nano robotics is an interdisciplinary field which involves microfabrication, robotics, medicine and materials science. This course will cover the basic principles in design, modelling, fabrication, and control of miniature robot and micro/nano-manipulation systems. In addition to basic background material, the course includes case studies of current micro/nano-systems, challenges and future trends, and potential applications. The course will focus on a team design project involving novel theoretical and/or experimental concepts for micro/nano-robotic systems with a team of students. Depending on the nature of the topic chosen, these projects can also involve review of literature, design of new micro/nano robots, simulation or experimental demonstrations.

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.	**Understand** the unique challenges due to the scaling factor in micro/nano robotics and automation at micro/nano scales.		✓	✓	
2.	**Review** the micro/nano robotic technologies and MEMS design principles to form a knowledge base for addressing the challenges at micro/nano scale.		✓	✓	✓
3.	**Apply** suitable theories and fabrication techniques to achieve automated manipulation of micro/nano objects, (such as biological cells, micro/nano particles).			✓	✓
4.	**Solve** practical problems within the emerging multidisciplinary areas (such as biomedical engineering, pharmaceutical applications) where extensive background knowledge and different perspectives of thinking are needed.			✓	✓
		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	Take place in a classroom setting and consists of lectures and student group discussions.	✓	✓	✓	✓	2 hours/week
Tutorial	Case presentation will be given to trigger the sparkles of thoughts in proposing innovative solutions for multidisciplinary problems. In-classroom quiz will be involved to strengthen the students' understanding of micro/nano robotic technologies.	✓	✓	✓	✓	1 hour/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%						
Project Presentation and Result	✓	✓	✓	✓	30%	
Project Report	✓	✓	✓	✓	20%	
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. Examination	Written exam at the end of the semester.	High	Significant	Moderate	Basic	Not even reaching marginal levels
2. Project Presentation and Result	Include 3 parts on oral, lab demo and written report.	High	Significant	Moderate	Basic	Not even reaching marginal levels
3. Project Report	Group reports but to include individual discussions	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. Examination	Written exam at the end of the semester.	High	Significant	Moderate	Not even reaching marginal levels
2. Project Presentation and Result	Include 3 parts on oral, lab demo and written report.	High	Significant	Moderate	Not even reaching marginal levels
3. Project Report	Group reports but to include individual discussions	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.)

Scaling of dimensions, actuation at micro/nano scales, microscopy imaging, electron microscopy, micro/nano fabrication, micro assembly, bio-microrobotics, bio-mimetic microrobots, nanorobotic manipulation, bio-MEMS, microrobotic manipulation.

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.)

N.A.

2.2 Additional Readings

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

1.	**Micro-/Nanorobots,** by Bradley J. Nelson, Lixin Dong, Fumihito Arai, Chapter 27 from *Springer Handbook of Robotics*, 2016 Ed.
2.	**Micro- and Nanomanipulation Tools,** by Yu Sun and X.Y. Liu, Wiley-VCH, 2015.
3.	**Nanopositioning Technologies: Fundamentals and Applications**, by C.H. Ru, X.Y. Liu, and Yu Sun, Springer-New York, 2016.
4.	**Fabrication and Characterization in the Micro-Nano Range**, by Lasagni, Fernando A., Lasagni, Andrés F. (2011 Eds.)
5.	**Foundations of MEMS**, by Chang Liu, Pearson Education Asia, 2012.
6.	**Fundamentals of BioMEMS and Medical Microdevices**, by Steven Saliterman, 2005.