City University of Hong Kong
Course Syllabus

offered by
Department of Mechanical Engineering
with effect from Semester A 2022 / 23

Part I Course Overview

Course Title:	Microfluidics: From Fundamentals to Applications
Course Code:	MNE8120
Course Duration:	1 semester
Credit Units:	3 credits
Level:	R8
Medium of Instruction:	English
Medium of Assessment:	English
Prerequisites: *(Course Code and Title)*	Nil
Precursors: *(Course Code and Title)*	Bachelor level Fluid Mechanics
Equivalent Courses: *(Course Code and Title)*	MNE6127 Microfluidics: From Fundamentals to Applications
Exclusive Courses: *(Course Code and Title)*	Nil

Part II Course Details

1. Abstract

Microfluidics technology involves systems that manipulate and process small amounts of fluids at the microscale, which has been matured into a multidisciplinary subject that profoundly impacts both scientific research and real-world products. This course is to teach the students who are seeking a degree of Doctor of Philosophy relevant to fluid mechanics, covering an introduction to the fundamental concepts, manufacturing methods, basic classifications, and practical applications of microfluidic systems. The course aims to equip students with knowledge of both fundamentals and applications of microfluidics, with deep insight into various microfluidic systems useful for tackling key issues in multidisciplinary fields such as engineering, chemistry, biology, and medicine, and with skills in analysing and designing microfluidic systems for advanced research and development applications.

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** fundamental concepts, manufacturing methods, basic classifications, and practical applications of microfluidics technology.		✓		
2.	**Explain** the features and dynamics of microscale fluid flows and calculate the problems with fluid mechanics.		✓	✓	
3.	**Identify** the microfluidic systems and related fluid mechanics in real-world products, reveal the underlying scientific principle and problem, analyse the problem with critical thinking, and demonstrate the idea with a mini-project.			✓	
4.	**Apply** the concepts, principles, and methods related to microfluidics to the analysis and design of microsystems for advanced research and development applications.			✓	✓
** If weighting is assigned to CILOs, they should add up to 100%.*		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. Teaching and Learning Activities (TLAs)

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

TLA	Brief Description	CILO No.				Hours/week (if applicable)
		1	2	3	4	
Lecture	Taken place in the classroom, the main teaching activities will be in the form of lectures, which will be given on the topics of the keyword syllabus.	✓	✓	✓	✓	2 hrs/week
Tutorial	Taken place in the classroom, tutorials are problem-solving sessions used to strengthen students' understanding of the contents by learning different microfluidics applications.	✓	✓	✓	✓	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%						
Test/Assignments	✓	✓			20%	
Mini-projects			✓	✓	40%	
Examination: 40% (duration: 2 hours)						
Examination	✓	✓			40%	
** The weightings should add up to 100%.*					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 in Semester A 2022/23 and thereafter

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B)	Marginal (B-, C+, C)	Failure (F)
1. Test/Assignments	Ability to understand basic concepts related to microfluidics.	75%-100%	65%-74%	50%-64%	<50%
2. Mini-projects	Ability to explain in detail and apply the learned knowledge to the analysis and design of systems using microfluidic components for advanced scientific research and practical applications.	Strong evidence of critical thinking; good capacity to analyse problem; 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 fairly profiting from the project; mediocre understanding of the subject matter; fair evidence of familiarity with 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%	65%-74%	50%-64%	<50%

Applicable to students admitted before Semester A 2022/23

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 advanced 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%

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.)

Microfabrication
Microscale fluid mechanics
Electrokinetics
Micromixing
Surface wettability
Droplet microfluidics
Digital microfluidics
Inertial microfluidics
Open microfluidics
Microfluidics-enabled soft manufacture

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.	**Nam-Trung Nguyen, Steven T. Wereley, and Seyed Ali Mousavi Shaegh, "Fundamentals and Applications of Microfluidics", Artech House, 3rd Edition, 2019.**
2.	Yuxiang Zhang and Liqiu Wang, "Microfluidics: Fabrication, Droplets, Bubbles and Nanofluids Synthesis". *Advances in Transport Phenomena*, 171-294, Springer-Verlag, Heidelberg, 2011.
3.	Patrick Tabeling, "Introduction to Microfluidics", OUP Oxford, 2005.
4.	Edited by Bingcheng Lin, "Microfluidics: Technologies and Applications", Springer Berlin Heidelberg, 2011.
5.	Jean Berthier, "Micro-Drops and Digital Microfluidics", Elsevier, 2nd Edition, 2013.
6.	Jean Berthier, Kenneth A Brakke, and Erwin Berthier, "Open Microfluidics", John Wiley & Sons, 2016.
7.	Pingan Zhu and Liqiu Wang, "Microfluidics-Enabled Soft Manufacture", Springer Nature, 2022.

2.2 Additional Readings

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

Students are encouraged to seek out related research publication to widen their scope in the subjects.