

MNE4122: INTRODUCTION TO MICROFLUIDICS

Effective Term

Semester B 2024/25

Part I Course Overview

Course Title

Introduction to Microfluidics

Subject Code

MNE - Mechanical Engineering

Course Number

4122

Academic Unit

Mechanical Engineering (MNE)

College/School

College of Engineering (EG)

Course Duration

One Semester

Credit Units

3

Level

B1, B2, B3, B4 - Bachelor's Degree

Medium of Instruction

English

Medium of Assessment

English

Prerequisites

Nil

Precursors

Nil

Equivalent Courses

Nil

Exclusive Courses

Nil

Part II Course Details

Abstract

Microfluidics technology has been matured into a multidisciplinary subject that profoundly impacts both scientific research and real-world products. This course covers 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 on various microfluidic systems used for tackling key issues in multidisciplinary areas, and with skills in analysing and designing microfluidic systems for solving practical problems.

Course Intended Learning Outcomes (CILOs)

CILOs		Weighting (if DEC-A1 DEC-A2 DEC-A3 app.)			
1	Describe fundamental concepts, manufacturing methods, basic classifications, and practical applications of microfluidics.		x		
2	Explain the features and dynamics of microscopic fluid flows.		x	x	
3	Identify the microfluidic systems used in real-world products.			x	
4	Apply the concepts, principles, and methods related to microfluidics to the analysis and design of products for satisfying the actual needs.			x	x

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.

Learning and Teaching Activities (LTAs)

LTAs		Brief Description	CILO No.	Hours/week (if applicable)
1	Lecture	Lectures will be given on the topics of the keyword syllabus.	1, 2, 3, 4	3 hrs/week
2	Mini-project	Students will be asked to carry out a mini-project on the design and analysis of a new microfluidic product for tackling a currently-unsolved issue.	1, 2, 3, 4	

Assessment Tasks / Activities (ATs)

ATs		CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Test/Assignments	1, 2, 3, 4	20	In-class quizzes
2	Mini-project	1, 2, 3, 4	20	Presentation + report submission on a given topic

Continuous Assessment (%)

40

Examination (%)

60

Examination Duration (Hours)

2

Additional Information for ATs

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

Assessment Rubrics (AR)**Assessment Task**

Test/Assignments

Criterion

Ability to understand basic concepts related to microfluidics.

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)

Basic

Failure (F)

Not even reaching marginal levels

Assessment Task

Mini-project

Criterion

Ability to explain in detail and apply the learned knowledge to the analysis and design of products using microfluidic components to meet the practical needs.

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)

Basic

Failure (F)

Not even reaching marginal levels

Assessment Task

Examination

Criterion

Ability to understand the key concepts, principles, methods, and applications of microfluidic systems used in both scientific research and real-world products.

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)

Basic

Failure (F)

Not even reaching marginal levels

Additional Information for AR

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

Keyword Syllabus

- Microfluidic devices
- Microscopic fluid flows
- Droplet microfluidics
- Inertial microfluidics
- Digital microfluidics
- Paper-based microfluidics
- Lab-on-a-chip microsystems and applications in chemistry, biology, and medicine
- Microfluidic synthesis of nanomaterials, microparticles/capsules, microfibers, and membranes

Reading List

Compulsory Readings

Title	
1	Nil

Additional Readings

Title	
1	Edited by Yujun Song, Daojian Cheng, and Liang Zhao, “Microfluidics: Fundamentals, Devices, and Applications” , John Wiley & Sons, 2018.
2	Edited by S. Kakaç, B. Kosoy, D. Li, and A. Pramuanjaroenkij, “Microfluidics Based Microsystems: Fundamentals and Applications” , Springer, 2010
3	Edited by Dongqing Li, “Encyclopedia of Microfluidics and Nanofluidics” , Springer, 2008.
4	Nam-Trung Nguyen, Steven T. Wereley, and Seyed Ali Mousavi Shaegh, “Fundamentals and Applications of Microfluidics” , Artech House, 3rd Edition, 2019.