MNE3125: FLUID MECHANICS FOR ENERGY-RELATED APPLICATIONS

Effective Term
Semester A 2022/23

Part I Course Overview

Course Title
Fluid Mechanics for Energy-Related Applications

Subject Code
MNE - Mechanical Engineering
Course Number
3125

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

Additional Information
#Prerequisites which are not part of the Major Requirement are waived for students admitted with Advanced Standing.

Part II Course Details

Abstract

Although droplets are tiny and ordinary, their power and impact can be large and far-reaching. One recent breakthrough technology is that we can use a new generation of droplet-based electricity generator to produce electrical power, and it has been demonstrated that one drop of rain can light up 100 LED bulbs.

This course introduces new concepts of fluid mechanics and droplets. The objectives of this application-focused course include: (a) to develop the fundamental principles of fluid mechanics and to explore the new implications of these principles; (b) to develop the problem-solving skills essential to good engineering practice of fluid mechanics in real-world applications. This course also aims to provide the students with the opportunity to intergrade the knowledge they acquired in classroom and apply it in real work setting; develop hands-on skills through industry-supported projects; and develop an understanding of the real-world operation of industry, based on which students can further plan his/her career.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Describe the basic principles and theories and single-phase (bubbles, droplets) and multiphase (slurries) systems.			x	
2	Identify fluid-related real world engineering problems.		x		
3	Conduct visualization experiments in laboratory sessions to analyse fluid-related mechanical engineering problems with theories.		x		
4	Build laboratory-scale prototypes to model the real world engineering systems.		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.

Teaching and Learning Activities (TLAs)

	TLAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lecture	Introduce striking fluid mechanics phenomena using various visualization techniques. Provide room to clarify doubts that would enhance the understanding of the subject.	1, 2, 3	3 hrs for 13 weeks

2	Laboratory Work	Investigate concepts through hand-on experiments; acquire skills in handling of apparatus and in engineering report write up; promote active participation.	1, 2, 3, 4	3 hrs for 4 weeks

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Tests and Assignments	1, 2, 3	20	One mid-term test
2	Laboratory Reports	1, 2, 3, 4	20	2 reports to be submitted

Continuous Assessment (%)

40

Examination (%)

60

Examination Duration (Hours)

3

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

Tests and Assignments

Criterion

1.1 Capacity for understanding the key concepts, principles and theories of some new fluid mechanics phenomena.
1.2 Ability to analyse and solve related engineering problems.

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

Laboratory Reports

Criterion

2.1 Capacity for self-learning to understand the principles of fluid mechanics through performing experiments by following instructions given.
2.2 Ability to analyse and present the results of experiments in the proper technical report format.

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

3.1 Ability to explain the basic principles and fundamental concepts of new fluid mechanics phenomena.
3.2 Capacity for analysing and solving given problems using relevant and appropriate formulae.

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

- Flow visualization
- Viscosity, rheology, surface tension
- Water-droplet dispensers
- Reynolds number, laminar flow, turbulent flow
- Liquid spreading, bouncing, jumping, coalescence
- Nature-inspired fluid flow
- Condensation, boiling, Leidenfrost
- Fog and dew harvesting
- Photothermal
- Water-energy nexus
- Water kinetic energy harvesting
- Programmed droplet transport
- Particle flow instability
- Water-to-electricity
- Triboelectric nanogenerator (TENG)
- Large scale prototyping

Reading List

Compulsory Readings

	Title
1	Theodore L. Bergman, Adrienne S. Lavine, Frank P. Incropera, David P. DeWitt. Fundamentals of Heat and Mass Transfer. 7thedition. New York, NY: John Wiley and Sons, 2011. ISBN: 978-0-470-50197-9.
2	Collier, J. G., and J. R. Thome. Convective Boiling and Condensation. 3rd ed. New York, NY: Oxford University Press, 1996. ISBN: 9780198562962.
3	Sarit K. Das, Stephen U. S. Choi, Wenhua Yu, T. Pradeep. Nanofluids: Science and Technology.John Wiley & Sons, Inc., 2008. Online ISBN: 978047018069
4	Xu W.H., Zheng H., Liu Y., Zhou X., Zhang C., Song Y., Deng X., Leung M., Yang Z., Xu R.X., Wang Z.L., Zeng X.C., Wang Z.K. A droplet-based electricity generator with high instantons power density. Nature 578, 392-396, 2020

Additional Readings

	Title
1	Nil