MNE4130: INTRODUCTION TO MULTIPHASE FLOW MODELING

Effective Term
Semester B 2023/24

Part I Course Overview

Course Title
Introduction to Multiphase Flow Modeling

Subject Code
MNE - Mechanical Engineering
Course Number
4130

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
MNE3122 Fluid Mechanics

Precursors
MNE3121 Heat Transfer

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract

A gas-liquid two-phase flow is a flow in which gas and liquid phases are mixed. The heat and mass transfer through the gas and liquid interfaces is used in various industrial equipment, such as heat exchangers, nuclear reactors, thermal management systems in space vehicles, chemical reactors, petroleum pipelines, computer chip cooling systems, air-lubrication systems in cargo ships, etc. The innovative design, optimization, safety evaluation, and performance assessment for two-phase flow equipment requires a comprehensive understanding of two-phase flow. This course introduces the fundamental concepts and methods of two-phase heat transfer. The main objectives of this course are: (a) to develop the fundamental principles of two-phase heat transfer and to explore the implications of these principles; (b) to study, analyze and design two-phase heat transfer systems through the application of these fundamental principles; (c) to develop the problem-solving skills essential to good engineering practice of two-phase heat transfer in real-world applications.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Develop the fundamental principles of two-phase heat transfer.			x	
2	Apply the fundamental principles of two-phase heat transfer to thermal systems.			x	
3	Analyze and design heat transfer systems through the application of the fundamental principles.			x	
4	Develop the problem-solving skills essential to good engineering practice of two-phase heat transfer in real-world applications.			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	Classroom lectures on the topics of the keyword syllabus.	1, 2, 3, 4	3 hrs for 10 weeks
2	Project Work	Mutliphase flow projects on the topics of the keyword in the syllabus.	1, 2, 3, 4	3 hrs for 3 weeks

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Assignments	1, 2, 3, 4	30	Students will attempt assignment (HW and Quiz).

2	Project Reports	2, 3, 4	30	Students will perform project and write project reports.

Continuous Assessment (%)

60

Examination (%)

40

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

Assignments

Criterion

Ability to describe and apply the fundamental principles of two-phase flow. Ability to analyze and design two-phase flow systems through the application of fundamental principles.

Excellent (A+, A, A-)

Strong evidence of original thinking; good organization, capacity to analyze and synthesize; superior grasp of subject matter; evidence of extensive knowledge base.

Good (B+, B, B-)

Significant evidence of grasp of subject, some evidence of critical capacity and analytic ability; reasonable understanding of issues; evidence of familiarity with course matter

Fair (C+, C, C-)

Student is profiting from the university experience; understanding of two-phase flow; ability to develop solutions to simple problems in the course.

Marginal (D)

Basic familiarity with the subject matter to enable the student to progress without repeating the course.

Failure (F)

Little evidence of familiarity with the subject matter; weakness in critical and analytic skills: very limited demonstration of correct use knowledge in two-phase flow.

Assessment Task

Project Reports

Criterion

Ability to analyze and design two-phase flow systems through the application of the fundamental principles.

Excellent (A+, A, A-)

Strong evidence of critical thinking; good organization, capacity to analyze and synthesize; superior grasp of subject matter; evidence of extensive knowledge of the project matters concerned.

Good (B+, B, B-)

Evidence of grasp of subject, some evidence of critical capacity and analytic ability; reasonable understanding of issues; evidence of familiarity with project.

Fair (C+, C, C-)

Student who is profiting from the project class; understanding of the subject; ability to develop solutions to concerning the project.

Marginal (D)

Sufficient familiarity with the project content to enable the student to move on to other project materials.

Failure (F)

Little evidence of familiarity with the project class materials; weakness in critical and analytic skills; limited, or irrelevant use of information.

Assessment Task

Examination

Criterion

Ability to describe and apply the fundamental principles of two-phase flow. Ability to analyze and design two-phase flow systems through the application of fundamental principles.

Excellent (A+, A, A-)

Strong evidence of original thinking; good organization, capacity to analyze and synthesize; superior grasp of subject matter; evidence of extensive knowledge base

Good (B+, B, B-)

Significant evidence of grasp of subject, some evidence of critical capacity and analytic ability; reasonable understanding of issues; evidence of familiarity with course matter

Fair (C+, C, C-)

Student is profiting from the university experience; understanding of two-phase flow; ability to develop solutions to simple problems in the course.

Marginal (D)

Basic familiarity with the subject matter to enable the student to progress without repeating the course.

Failure (F)

Little evidence of familiarity with the subject matter; weakness in critical and analytic skills: very limited demonstration of correct use knowledge in two-phase flow.

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

Drift-flux model, Two-fluid model, Flow patterns, Void fraction, Interfacial area concentration, Boiling, Condensation, Subcooled boiling, Saturated boiling, Transition boiling, Film boiling, Critical heat flux, Heat transfer coefficient.

Reading List

Compulsory Readings

	Title
1	George Yadigaroglu, Geoffrey F. Hewitt (Editors), Introduction to Multiphase Flow-Basic Concepts, Applications and Modeling, SpringerLink (2018) ISBN: 978-3-319-58717-2.

Additional Readings

	Title
1	Mamoru Ishii, Takashi Hibiki, Thermo-Fluid Dynamics of Two-Phase Flow, SpringerLink (2011) ISBN: 978-1-4899-8249-0.
2	Mirza Mohammed Shah, Two-Phase Heat Transfer, Wiley (2021) ISBN: 978-1-119-61867-6.