MNE8109: THERMODYNAMICS AND KINETICS

Effective Term
Semester A 2026/27

Part I Course Overview

Course Title
Thermodynamics and Kinetics

Subject Code
MNE - Mechanical Engineering
Course Number
8109

Academic Unit
Mechanical Engineering (MNE)

College/School
College of Engineering (EG)

Course Duration
One Semester

Credit Units
3

Level
R8 - Research Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
Nil

Precursors
Nil

Equivalent Courses
MNE6140 Thermodynamics and Kinetics

Exclusive Courses
Nil

Part II Course Details

Abstract

This course aims to cover the fundamental and advanced topics related to thermodynamics and kinetics of materials for our research postgraduate students, from the statistics mechanics, the thermodynamics laws (first and second laws), phase transition, surfaces and interface, instability to defects in materials.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Understand the principles and fundamentals of thermodynamics and kinetics.			x	
2	Able to study the literatures related to thermodynamics and kinetics of materials.		x	x	
3	Formulate an engineering problem with the principles of thermodynamics and kinetics.			x	
4	Apply the principles of thermodynamics and kinetics to solve an engineering problem.			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	This includes typical lectures on different topics of thermodynamics and kinetics.	1, 2, 3, 4	39 hours

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks ("-" for nil entry)	Allow Use of GenAI?
1	In-class quiz and tests	2, 3, 4	20	At least one mid-term or in-class quiz to be arranged	No
2	Homework	1, 2, 3, 4	20	3-4 assignments to be submitted	Yes

Continuous Assessment (%)

40

Examination (%)

60

Examination Duration (Hours)

3

Minimum Continuous Assessment Passing Requirement (%)

30

Minimum Examination Passing Requirement (%)

30

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

In-class quiz and tests (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

Understand the principles and fundamentals of thermodynamics and kinetics, formulate the engineering problems with the above mentioned principles.

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

Homework (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

Able to study the literatures related to thermodynamics and kinetics of materials, Understand the principles and fundamentals of thermodynamics and kinetics, formulate and solve the engineering problems with the above mentioned principles.

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 (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion
formulate and solve the engineering problems with the given principles of thermodynamics and kinetics.

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
In-class quiz and tests (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Understand the principles and fundamentals of thermodynamics and kinetics, formulate the engineering problems with the above mentioned principles.

Excellent
(A+, A, A-) High

Good
(B+, B) Significant

Marginal
(B-, C+, C) Moderate

Failure
(F) Not even reaching marginal levels

Assessment Task
Homework (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion

Able to study the literatures related to thermodynamics and kinetics of materials, Understand the principles and fundamentals of thermodynamics and kinetics, formulate and solve the engineering problems with the above mentioned principles.

Excellent

(A+, A, A-) High

Good

(B+, B) Significant

Marginal

(B-, C+, C) Moderate

Failure

(F) Not even reaching marginal levels

Assessment Task

Examination (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion

formulate and solve the engineering problems with the given principles of thermodynamics and kinetics.

Excellent

(A+, A, A-) High

Good

(B+, B) Significant

Marginal

(B-, C+, C) Moderate

Failure

(F) Not even reaching marginal levels

Part III Other Information

Keyword Syllabus

- The zeroth, first, second and third laws of thermodynamics; internal energy; entropy; enthalpy; free energy
- Statistic mechanics; probability; temperature; partition function; diffusion
- Transition state theory;
- Phase transition; phase diagrams; phase stability; crystal and glass; solid solution and metallic compounds
- Defects; vacancy; dislocation; surface and interface; fracture

Reading List

Compulsory Readings

	Title
1	N.A.

Additional Readings

	Title
1	Gerald H. Meier, Thermodynamics of surfaces and interfaces: Concepts in inorganic materials; Cambridge University Press.
2	R.K. Pathria and Paul D. Beale, Statistical mechanics; the 3rd Edition; Elsevier.
3	Svein Stolen, Tor Grande and Neil L Allan, Chemical Thermodynamics of Materials: Macroscopic and Microscopic Aspects, John Wiley & Sons, Ltd.
4	U.F. Kocks, A.S. Argon and M.F. Ashby, Thermodynamics and kinetics of slip, Pergamon Press Ltd.
5	Y. Austin Chang, W. Alan Oates, Materials Thermodynamics, Johns Wiley & Sons, Inc.
6	Taiji Nishizawa, Thermodynamics of microstructures, 2008 ASM International®