MSE5303: STRUCTURE AND DEFORMATION OF MATERIALS

Effective Term
Semester A 2025/26

Part I Course Overview

Course Title
Structure and Deformation of Materials

Subject Code
MSE - Materials Science and Engineering
Course Number
5303

Academic Unit
Materials Science and Engineering (MSE)

College/School
College of Engineering (EG)

Course Duration
One Semester

Credit Units
3

Level
P5, P6 - Postgraduate Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
Nil

Precursors
Nil

Equivalent Courses
AP5303 Structure and Deformation of Materials (From the old curriculum)

Exclusive Courses
Nil

Part II Course Details

Abstract

This course is designed to provide students with a general knowledge of the structure of materials which is the essential foundation for the understanding of other courses in this programme. In the meantime, we aim to providing students with an understanding of the behaviour of materials under stress or subject to environmental attack. An overview on structure and deformation of nanomaterials will also be offered.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Identify the difference in structures and properties of various classes of materials.	30	x	x	x
2	Identify the new structure and deformation mechanism of nano-scaled materials.	20	x		x
3	Describe and explain the effect of thermo-mechanical treatment on materials properties.	20		x	x
4	Identify and analyze the deformation, fracture and failure mechanisms of materials so as to generate creative solutions for different applications.	30	x	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	Students will engage with key concepts, such as different structures, mechanical properties of materials, deformation of nanomaterials etc.	1, 2, 3, 4	2
2	Tutorial	Students will engage in tutorials discussions to improve the understanding of lecture contents.	1, 2, 3, 4	1
3	Laboratory	Students will carry out experiments on the structure and mechanical properties of materials.	1, 3, 4	3 hrs/wk for 2 weeks

4	Reading	Students will read books and study articles related to the deformation and structure of materials.	1, 2, 3, 4	1

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks ("-" for nil entry)	Allow Use of GenAI?
1	Assignments	1, 2, 3, 4	20	-	No
2	Lab Reports	1, 2, 3, 4	20	-	No
3	Quizzes	1, 2	10	-	No
4	Mid-term test	1, 2, 3, 4	20	-	No

Continuous Assessment (%)

70

Examination (%)

30

Examination Duration (Hours)

2

Assessment Rubrics (AR)

Assessment Task

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

Criterion

CAPABILITY for SELF-DIRECTED learning and problem solving

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal

(D) Basic

Failure

(F) Not even reaching marginal level

Assessment Task

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

Criterion

ABILITY to explain experimental phenomena and theory related.

Excellent

(A+, A, A-) High

Good
(B+, B, B-) Significant

Fair
(C+, C, C-) Moderate

Marginal
(D) Basic

Failure
(F) Not even reaching marginal level

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

Criterion
ABILITY to identify the fundamental microstructures and general materials properties.

Excellent
(A+, A, A-) High

Good
(B+, B, B-) Significant

Fair
(C+, C, C-) Moderate

Marginal
(D) Basic

Failure
(F) Not even reaching marginal level

Assessment Task
Mid-term test (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion
ABILITY to describe and explain the inner relationship between material properties and microstructures.

Excellent
(A+, A, A-) High

Good
(B+, B, B-) Significant

Fair
(C+, C, C-) Moderate

Marginal
(D) Basic

Failure
(F) Not even reaching marginal level

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

Criterion
Understanding concepts introduced in class and Ability for problem solving

Excellent
(A+, A, A-) High

Good
(B+, B, B-) Significant

Fair
(C+, C, C-) Moderate

Marginal
(D) Basic

Failure
(F) Not even reaching marginal level

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

Criterion
CAPABILITY for SELF-DIRECTED learning and problem solving

Excellent
(A+, A, A-) High

Good
(B+, B) Moderate

Marginal
(B-, C+, C) Basic

Failure
(F) Not even reaching marginal level

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

Criterion
ABILITY to explain experimental phenomena and theory related.

Excellent
(A+, A, A-) High

Good
(B+, B) Moderate

Marginal
(B-, C+, C) Basic

Failure
(F) Not even reaching marginal level

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

Criterion
ABILITY to identify the fundamental microstructures and general materials properties.

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Assessment Task
Mid-term test (for students admitted from Semester A 2022/23 to Summer Term 2024)

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

Criterion

Understanding concepts introduced in class and Ability for problem solving

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Failure
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Part III Other Information

Keyword Syllabus

- Overview of different classes of materials and crystalline phases (6 hours)
Metals, ceramics, polymers, and construction materials. Structure, size effect (micro to nano), dislocation, grain/interphase boundary.
- Structure and deformation of nano-scaled materials (5 hours)
- Plastic deformation of naonmaterials, defects structure of nanomaterials, deformation and fracture mechanism of nanomaterials, superplasticity
- Mechanical behaviour (12 hours)
The elastic moduli: bonding between atoms, physical basis of modulus, case studies of modulus-limited design. The yield strength and tensile strength: Micro- and nano-hardness, ductility, dislocations and yielding in crystals, strengthening method, plasticity of polycrystals, (negative) Hall-Petch relation, continuum aspects of plastic flow. Fracture and toughness: micro-mechanism of fast fracture, fatigue failure. Creep and creep fracture: kinetic theory of diffusion, mechanism of creep, creep resistant materials.
- Introduction to corrosion (3 hours)
Basic electrochemistry, mechanism of various forms of corrosion, anodic and cathodic protection, corrosion inhibitors, surface modification methods for improving wear and corrosive resistance.

Reading List

Compulsory Readings

	Title
1	Nil

Additional Readings

	Title
1	Michael F. Ashby and David R.H. Jones, "Engineering materials 1: an introduction to properties, applications and design", 4th Ed, Amsterdam; Boston: Elsevier Butterworth-Heinemann, 2012.
2	Michael F. Ashby and David R.H. Jones, "Engineering materials 2: an introduction to microstructures, processing and design", 3rd Ed, Oxford; Burlington, MA: Elsevier/Butterworth-Heinemann, 2006.
3	R A Flinn and P K Trojan, "Engineering Materials and Their Applications", 4th Ed, John Wiley & Sons, New York, 1990.
4	William D Callister, Jr, and David G. Rethwisch "Materials Science and Engineering, An Introduction", 8th Ed, Wiley, New York, 2010.
5	Bangwei Zhang, chapter 6 of "Physical Fundamentals of Nanomaterials", Chemical Industry Press, 2018.