City University of Hong Kong
Course Syllabus

offered by Department of Materials Science and Engineering
with effect from Semester A 2024/25

Part I Course Overview

Course Title:	**Structure and Deformation of Materials**
Course Code:	**MSE5303**
Course Duration:	**One semester**
Credit Units:	**3**
Level:	**P5**
Medium of Instruction:	**English**
Medium of Assessment:	**English**
Prerequisites: *(Course Code and Title)*	**Nil**
Precursors: *(Course Code and Title)*	**Nil**
Equivalent Courses: *(Course Code and Title)*	**AP5303 Structure and Deformation of Materials (From the old curriculum)**
Exclusive Courses: *(Course Code and Title)*	**Nil**

Part II Course Details

1. 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.

2. Course Intended Learning Outcomes (CILOs)

(CILOs state what the student is expected to be able to do at the end of the course according to a given standard of performance.)

No.	CILOs	Weighting* (if applicable)	Discovery-enriched curriculum related learning outcomes (please tick where appropriate)		
			A1	*A2*	*A3*
1.	Identify the difference in structures and properties of various classes of materials.	30%	√	√	√
2.	Identify the new structure and deformation mechanism of nano-scaled materials.	20%	√		√
3.	Describe and explain the effect of thermo-mechanical treatment on materials properties.	20%		√	√
4.	Identify and analyze the deformation, fracture and failure mechanisms of materials so as to generate creative solutions for different applications.	30%	√	√	√
** If weighting is assigned to CILOs, they should add up to 100%.*		100%			

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.

3. Learning and Teaching Activities (LTAs)

(LTAs designed to facilitate students' achievement of the CILOs.)

LTA	Brief Description	CILO No.						Hours/week (if applicable)
		1	2	3	4			
Lecture	Students will engage with key concepts, such as different structures, mechanical properties of materials, deformation of nanomaterials etc.	√	√	√	√			2
Tutorial	Students will engage in tutorials discussions to improve the	√	√	√	√			1

	understanding of lecture contents.							
Laboratory	Students will carry out experiments on the structure and mechanical properties of materials.	√		√	√			3 hrs/wk for 2 weeks
Reading	Students will read books and study articles related to the deformation and structure of materials.	√	√	√	√			1

4. Assessment Tasks/Activities (ATs)

(ATs are designed to assess how well the students achieve the CILOs.)

Assessment Tasks/Activities	CILO No.						Weighting*	Remarks
	1	2	3	4				
Continuous Assessment: 70%								
Assignments	√	√	√	√			20%	
Lab Reports	√	√	√	√			20%	
Quizzes	√	√					10%	
Mid-term test	√	√	√	√			20%	
Final examination: (duration: 2 hours)	√	√	√	√			30%	
** The weightings should add up to 100%.*							100%	

5. Assessment Rubrics

(Grading of student achievements is based on student performance in assessment tasks/activities with the following rubrics.)

Applicable to students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1. Assignments	CAPABILITY for SELF-DIRECTED learning and problem solving	High	Significant	Moderate	Basic	Not even reaching marginal level
2. Lab Reports	ABILITY to explain experimental phenomena and theory related.	High	Significant	Moderate	Basic	Not even reaching marginal level
3. Quizzes	ABILITY to identify the fundamental microstructures and general materials properties.	High	Significant	Moderate	Basic	Not even reaching marginal level
4. Mid-term test	ABILITY to describe and explain the inner relationship between material properties and microstructures.	High	Significant	Moderate	Basic	Not even reaching marginal level
5. Examination	Understanding concepts introduced in class and Ability for problem solving	High	Significant	Moderate	Basic	Not even reaching marginal level

Applicable to students admitted from Semester A 2022/23 to Summer Term 2024

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B)	Marginal (B-, C+, C)	Failure (F)
1. Assignments	CAPABILITY for SELF-DIRECTED learning and problem solving	High	Moderate	Basic	Not even reaching marginal level
2. Lab Reports	ABILITY to explain experimental phenomena and theory related.	High	Moderate	Basic	Not even reaching marginal level
3. Quizzes	ABILITY to identify the fundamental microstructures and general materials properties.	High	Moderate	Basic	Not even reaching marginal level
4. Mid-term test	ABILITY to describe and explain the inner relationship between material properties and microstructures.	High	Moderate	Basic	Not even reaching marginal level
5. Examination	Understanding concepts introduced in class and Ability for problem solving	High	Moderate	Basic	Not even reaching marginal level

Part III Other Information (more details can be provided separately in the teaching plan)

1. 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.

2. Reading List

2.1 Compulsory Readings

(Compulsory readings can include books, book chapters, or journal/magazine articles. There are also collections of e-books, e-journals available from the CityU Library.)

Nil

2.2 Additional Readings

(Additional references for students to learn to expand their knowledge about the subject.)

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.