City University of Hong Kong
Course Syllabus

offered by Department of Materials Science and Engineering
with effect from Semester A 2022/23

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

- 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.
- To provide students with an understanding of the behaviour of materials under stress or subject to environmental attack.
- To provide students an overview on structure and deformation of nanomaterials.

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.	Recognise the difference in structures and properties of various classes of materials.	30%	√	√	√
2.	Recognize new structure and deformation mechanism of nano-scaled materials	20%	√		√
3.	Relate the rate of thermo-mechanical treatment with materials properties.	20%		√	√
4.	Recognize the deformation, fracture and failure mechanisms 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 self-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. Teaching and Learning Activities (TLAs)

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

TLA	Brief Description	CILO No.						Hours/week (if applicable)
		1	2	3	4			
Lecture	Explain key concepts, such as different structures, mechanical properties of materials, deformation of nanomaterials etc.	√	√	√	√			2
Tutorial	Checking students' understanding to lecture contents.	√	√	√	√			1
Laboratory	Requires students to understand	√		√	√			3 hrs/wk for 2

	structure and mechanical properties of materials by carrying out experiment tests.							weeks
Reading report	Each student is required to write a report on deformation and structure of materials.	√	√	√	√			1

In tutorial sessions (*Small class activities*), students will be encouraged to discuss and give oral presentations concerning the relationship between various materials as a result of creating different fabrication techniques in commonly used domestic and engineering products.

Students will be required to search for information from the internet, engineering handbooks and research papers related to the course contents. They will be requested to discuss and present the relevant knowledge in the mass classes and tutorials. This will be a good opportunity for obtaining the ability to critically review and appraise other's work.

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: 50%								
Assignments	√						30%	
Lab Reports	√	√	√	√			20%	
Examination: (duration: 2 hours)	√	√	√	√			50%	
** 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 in Semester A 2022/23 and thereafter

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. Reading Report	ABILITY to explain a topic related to Structure and deformation of materials	High	Moderate	Basic	Not even reaching marginal level
4. Examination	Understanding concepts introduced in class and Ability for problem solving	High	Moderate	Basic	Not even reaching marginal level

Applicable to students admitted before Semester A 2022/23

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. Reading Report	ABILITY to explain a topic related to Structure and deformation of materials	High	Significant	Moderate	Basic	Not even reaching marginal level
4. Examination	Understanding concepts introduced in class and Ability for problem solving	High	Significant	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 nanohardness, 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.