City University of Hong Kong
Course Syllabus

offered by
Department of Mechanical Engineering
with effect from Semester A 2022 / 23

Part I Course Overview

Course Title:	Mechanical Behaviour of Materials: From Metallic to Biomedical/Biological Materials
Course Code:	MNE8105
Course Duration:	One Semester
Credit Units:	3
Level:	R8
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)*	MBE6110/MNE6110/MBE8105 Mechanical Behaviour of Materials: From Metallic to Biomedical/Biological Materials
Exclusive Courses: *(Course Code and Title)*	Nil

Part II Course Details

1. Abstract

This course aims to provide a comprehensive treatment of the mechanical behaviour of materials with a balanced mechanics-materials approach, which connects the fundamental mechanisms to the wide range of mechanical properties of different materials under a variety of environments, such as metals, polymers, ceramics, composites, electronic materials, biomedical and biological materials. The unifying thread running throughout is that the nano/microstructure of a material controls its mechanical behaviour. Although this course is designed for the postgraduate students in mechanical, biomedical and materials engineering, it also provides useful knowledge for the practicing engineers involved with mechanical behaviour of materials. This course does not presuppose any extensive knowledge of materials.

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.	Be able to **describe** and **correlate** the structure and mechanical properties of different kinds of materials.		✓	✓	
2.	Be able to **describe** the key underlying physical principles and microscopic mechanisms behind the mechanical behavior of materials.		✓	✓	
3.	Be able to **assess** the environmental impacts on the mechanical properties and performance of materials.		✓	✓	
4.	Be able to **formulate** a problem using the physical principles related to the mechanical behavior of materials.			✓	
** If weighting is assigned to CILOs, they should add up to 100%.*		N.A.			

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	
Large Class Activities	During the large-class lectures, the teaching/learning is focused on mechanical behaviour of materials. The course also deals with the use of fundamental physical principles that govern the mechanical behaviour of materials to solve related engineering problems. Students' performance is assessed through homework, mid-term and final examination.	√	√	√	√	39 hours

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%						
Mid-term and In-class Quiz	√	√	√	√	30%	
Homework	√	√	√	√	20%	
Examination: 50% (2 hours)						
					100%	

For a student to pass the course, at least 30% of the maximum mark for both coursework and examination should be obtained.

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)
Mid-term and In-class Quiz	Each student is required to demonstrate the understanding of the physical principles governing the mechanical behaviour of materials and the ability of selecting a single relevant principle to solve a given engineering problem	High	Significant	Moderate	Not even reaching marginal levels
Homework	Each student is required to comprehend the physical principles and mechanisms governing the mechanical behaviour of materials and be able to solve the engineering problems with the necessary mathematic skills by applying a given physical principle	High	Significant	Moderate	Not even reaching marginal levels
Examination	Each student is required to demonstrate the mathematic skills and the ability of selecting multiple principles relevant to solve a given engineering problem related to the mechanical behaviour of materials	High	Significant	Moderate	Not even reaching marginal levels

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)
Mid-term and In-class Quiz	Each student is required to demonstrate the understanding of the physical principles governing the mechanical behaviour of materials and the ability of selecting a single relevant principle to solve a given engineering problem	High	Significant	Moderate	Basic	Not even reaching marginal levels
Homework	Each student is required to comprehend the physical principles and mechanisms governing the mechanical behaviour of materials and be able to solve the engineering problems with the necessary mathematic skills by applying a given physical principle	High	Significant	Moderate	Basic	Not even reaching marginal levels
Examination	Each student is required to demonstrate the mathematic skills and the ability of selecting multiple principles relevant to solve a given engineering problem related to the mechanical behaviour of materials	High	Significant	Moderate	Basic	Not even reaching marginal levels

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

1. Keyword Syllabus

(An indication of the key topics of the course.)

- metals, ceramics, polymers, blood vessels, articular cartilage
- plastic deformation of polymers and glasses, criteria for yielding and flow, hardness, plasticity of biological materials
- atomic and electronic point defects, line defects, interfacial and volumetric defects, twinning, grain size strengthening
- theoretical tensile strength, stress concentration, Griffith criterion, linear elastic fracture mechanics, fracture toughness, microscopic mechanisms of fracture
- diffusion creep, dislocation creep, creep in polymers, diffusion-related phenomena in electronic materials, superplasticity
- S-N curves, mean stress effect, fatigue crack propagation, corrosion, radiation damage

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.)

F.A. McClintock and A.S. Argon, "Mechanical Behavior of Materials", Addison-Wesley Publishing Company, Inc., 1966.
Marc Meyers and Krishan Chawla, "Mechanical Behavior of Materials", Cambridge University Press, 2009.
Y.C. Fung, "Biomechanics: Mechanical Properties of Living Tissues", Springer, 1993.