City University of Hong Kong
Course Syllabus

offered by
Department of Biomedical Engineering /
Department of Mechanical Engineering
with effect from Semester A 2018 / 19

Part I Course Overview

Course Title:	Mechanical Behaviour of Materials: From Metallic to Biomedical/Biological Materials
Course Code:	MBE6110
Course Duration:	1 semester
Credit Units:	3 credits
Level:	P6
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)*	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 soft and hard materials in conventional and bio-medical applications.			✓	
2.	Be able to describe the key physical principles and microscopic mechanisms behind the mechanical behavior of soft/hard materials in line with their applications in mechanical and bio-medical engineering.		✓		
3.	Be able to assess the effect of environments on the mechanical properties and performance of soft/hard materials which will be commonly used for mechanical and bio-medical engineering.				✓
4.	Be able to solve or suggest a solution to a problem related to the mechanical behavior of soft/hard materials that are key to mechanical and biomedical engineering.			✓	✓
		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	
Lecture	Explain key concepts and theories related to the mechanical behaviour of materials.	✓	✓	✓	✓	3 hrs/week
Homework/Examination	Require students to formulate and solve the scientific problems based on the theories and models discussed during lectures.	✓	✓		✓	N.A.
Mid-term Report	Require students to identify one key problem related to the mechanical behaviour of materials through literature survey and provide a feasible solution.	✓	✓	✓	✓	2 hrs/week

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 Report	✓	✓	✓	✓	30%	
Homework	✓	✓	✓	✓	20%	
Examination: 50% (duration: 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.)

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1. Examination	**Ability** to formulate and solve problems with accurate methods.	High	Significant	Moderate	Basic	Not even reaching marginal levels
2. Mid-term Report	**Capacity** for self-directed learning to understand/identify the key mechanisms/problems and Ability to explain the methodology and procedure.	High	Significant	Moderate	Basic	Not even reaching marginal levels
3. Homework	**Ability** to formulate and solve problems with accurate methods; **Capacity** for self-directed learning to understand the key mechanisms related to 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.)

1.	Marc Meyers and Krishan Chawla, "Mechanical Behavior of Materials", Cambridge University Press, 2009.

2.2 Additional Readings

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

1.	F.A. McClintock and A.S. Argon, "Mechanical Behavior of Materials", Addison-Wesley Publishing Company, Inc., 1966.
2.	Y.C. Fung, "Biomechanics: Mechanical Properties of Living Tissues", Springer, 1993.
3	Thomas H. Courtney, "Mechanical Behaviour of Materials", 2nd Ed., Waveland Press, Inc. 2000