

City University of Hong Kong
Course Syllabus

offered by Department of Mechanical and Biomedical Engineering
with effect from Semester A 2017/18

Part I Course Overview

Course Title: Mechanical Behaviour of Materials: From Metallic to Biomedical/Biological Materials

Course Code: MBE8105

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: MBE6110 Mechanical Behaviour of Materials: From Metallic to Biomedical/Biological Materials
(Course Code and Title)

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)

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			✓	
		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)

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)

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

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

- 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

Nil

2.2 Additional Readings

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.