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:	**Advanced Structural Materials**
Course Code:	**MSE6185**
Course Duration:	**One semester**
Credit Units:	**3**
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)*	**Nil**
Exclusive Courses: *(Course Code and Title)*	**Nil**

Part II Course Details

1. Abstract

This course will be focused on providing comprehensive understanding of scientific concepts and principles used for advanced structural materials, with emphasis on the advanced metallic materials. It will include the microstructures of solids, processing and fabrication, compositional adjustment, metallurgical principles, and development of structure-property correlation. The goal of this course is to achieve that senior and graduate students are able to (1) understand the basic concepts of the advanced structural materials; (2) select and design different structural materials with superior properties for various engineering fields; (3)identify and solve some critical issues in manufacturing and practical applications of these 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.	**Learn** the development for most common and advanced structural materials	15%	√		
2.	**Understand** the typical properties and applications of these materials	15%		√	
3.	**Identify** the inner relationship between material properties, processing, and microstructures	25%			√
4.	**Learn and apply** scientific and metallurgical principles used for alloy design and microstructural control	25%		√	
5.	**Demonstrate** the ability to solve crucial problems in manufacturing and practical applications of these materials	20%		√	
** 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	Hours/week (if applicable)					
		1	2	3	4	5	
Lectures/ Tutorials	Introducing fundamental theories and concepts	√	√	√	√	√	2 hrs/week
Quizzes	Classroom tests	√	√	√	√	√	0.5hrs/week
Assignments	Individual work	√	√	√	√	√	
Lab experiments	Group work: Putting theories and concepts into practice			√			2 hrs/session

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	5		
Continuous Assessment: 70%							
Quiz	√	√	√	√	√	20%	
Assignment	√	√	√	√	√	20%	
Mid-term test	√	√	√			20%	
Lab report			√			10%	
Examination: 30% (duration: 2 hours)							
** 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. Quiz	Ability to understand the fundamental theories and concepts	High	Moderate	Basic	Not even reaching marginal levels
2. Assignment	Capability for self-directed learning to strengthen the understanding of some critical scientific issues	High	Moderate	Basic	Not even reaching marginal levels
3.Lab report	Ability to use the basic methodology and procedure with accuracy in using the experimental techniques	High	Moderate	Basic	Not even reaching marginal levels
4. Mid-term test	Ability to identify and explain the inner relationship between material properties and microstructures	High	Moderate	Basic	Not even reaching marginal levels
5. Final examination	Ability to comprehensively master the scientific principles and use them to solve some theoretical and application problems	High	Moderate	Basic	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)
1. Quiz	Ability to understand the fundamental theories and concepts	High	Significant	Moderate	Basic	Not even reaching marginal levels
2. Assignment	Capability for self-directed learning to strengthen the understanding of some critical scientific issues	High	Significant	Moderate	Basic	Not even reaching marginal levels
3.Lab report	Ability to use the basic methodology and procedure with accuracy in using the experimental techniques	High	Significant	Moderate	Basic	Not even reaching marginal levels
4. Mid-term test	Ability to identify and explain the inner relationship between material properties and microstructures	High	Significant	Moderate	Basic	Not even reaching marginal levels
5. Final examination	Ability to comprehensively master the scientific principles and use them to solve some theoretical and application problems	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.)

(1). Overview of advanced structural materials
(2). States and microstructures of matters:
  (a). Atomic structures
  (b). Phase diagram and diffusion
  (c). Crystal structure and defect
  (d). Strengthening and toughening mechanisms
  (e). Advanced manufacturing
(3). Typical mechanical properties (elastic, strength, ductility, fracture toughness…)
(4). Non-mechanical Properties (grain growth, corrosive, oxidation…)
(5). Advanced structural materials:
  (a). Steels
  (b). Superalloys and intermetallics
  (c). High-entropy alloys
  (d). Light-weight alloys
  (e). Bulk metallic glasses (BMGs)
  (f). Structural-gradient alloys

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. Soboyejo, Winston O., and T. S. Srivatsan, eds. Advanced structural materials: properties, design optimization, and applications. CRC press, 2006.
2. Physical Metallurgy Principles, RE Reed-Hill and R Abbaschian, PWS-KENT Pub, Boston.

2.2 Additional Readings

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

1. Ferdinand P. Beer, E. Russell Johnston, John T. DeWolf and David F. Mazurek, Mechanics of Materials, 6th edition, McGraw-Hill, New York, 2012, ISBN: 978-0-07-131439-8.
2. Priester L. Grain boundaries: from theory to engineering[M]. Springer Science & Business Media, 2012.
3. Smith, William F. Structure and properties of engineering alloys. McGraw-Hill, 1993.
4. The superalloys: fundamentals and applications by Rogers C. Reed, Cambridge University Press, 2006.
5. Recent papers on nanostructured steels and intermetallic compounds by Profs. CT Liu, MW Chen, and Dr. T. Yang, et al.
6. Recent papers on structural-gradient metallic materials and SMAT materials by Prof. Jian Lu

Annex
(for GE courses only)

A. Please specify the Gateway Education Programme Intended Learning Outcomes (PILOs) that the course is aligned to and relate them to the CILOs stated in Part II, Section 2 of this form:

GE PILO	Please indicate which CILO(s) is/are related to this PILO, if any *(can be more than one CILOs in each PILO)*
PILO 1: Demonstrate the capacity for self-directed learning	1, 2, 3, 4, 5
PILO 2: Explain the basic methodologies and techniques of inquiry of the arts and humanities, social sciences, business, and science and technology	3, 4,
PILO 3: Demonstrate critical thinking skills	3, 4, 5
PILO 4: Interpret information and numerical data	3, 4,
PILO 5: Produce structured, well-organised and fluent text	3, 4, 5
PILO 6: Demonstrate effective oral communication skills	3, 4, 5
PILO 7: Demonstrate an ability to work effectively in a team	3, 4, 5
PILO 8: Recognise important characteristics of their own culture(s) and at least one other culture, and their impact on global issues	1, 2
PILO 9: Value ethical and socially responsible actions	1, 2
PILO 10: Demonstrate the attitude and/or ability to accomplish discovery and/or innovation	4, 5

GE course leaders should cover the mandatory PILOs for the GE area (Area 1: Arts and Humanities; Area 2: Study of Societies, Social and Business Organisations; Area 3: Science and Technology) for which they have classified their course; for quality assurance purposes, they are advised to carefully consider if it is beneficial to claim any coverage of additional PILOs. General advice would be to restrict PILOs to only the essential ones. (Please refer to the curricular mapping of GE programme: http://www.cityu.edu.hk/edge/ge/faculty/curricular_mapping.htm.)

B. Please select an assessment task for collecting evidence of student achievement for quality assurance purposes. Please retain at least one sample of student achievement across a period of three years.

Selected Assessment Task
1. MS thesis writing 2. Lab report