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:	Special Topics on Advanced Structural Materials
Course Code:	MNE8101
Course Duration:	One Semester
Credit Units:	3
Level:	R8
Medium of Instruction:	English
Medium of Assessment:	English
Prerequisites: *(Course Code and Title)*	Background knowledge in related disciplines is required and course registration will be subject to the approval of the Course Examiner
Precursors: *(Course Code and Title)*	Nil
Equivalent Courses: *(Course Code and Title)*	MBE6102/MNE6102/MBE8101 Special Topics on Advanced Structural Materials
Exclusive Courses: *(Course Code and Title)*	Nil

Part II Course Details

1. Abstract

This course will be focused on the understanding scientific and metallurgical principles used for material processing and fabrication, microstructural control, composition adjustment, mechanical and metallurgical property evaluation, and development of structure-property correlation for advanced structural materials (with emphasis on metallic materials). The goal of this course is to achieve that senior and graduate students are able to select and design structural materials with superior properties as strength members used in advanced engineering systems. The materials topics intended to cover in this course will include phase diagram and microstructural control, hardening of structural materials, conventional and nanostructured steels with high strength, bulk metallic glasses (BMGs): Glass forming ability, atomic structures and mechanical properties, high-temperature superalloys, structural-gradient metallic materials, high-temperature refractory metals and alloys, and light-weight Ti-based alloys (including two-phase TiAl intermetallic alloys).

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	**Describe** scientific and metallurgical principles used for alloy design and microstructural control		✓	✓	
2	**Describe and apply** advanced ferritic steels and nanostructured materials for structural applications			✓	✓
3	**Learn and apply** light-weight and structural-gradient materials for structural applications			✓	✓
4	**Learn and apply** bulk metallic glasses (BMGs) for structural applications			✓	✓
5	**Learn and apply** high-temperature refractory alloys for structural applications			✓	✓
6	**Learn and apply** Ni-based superalloys for structural applications			✓	✓
** 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	5	6	
Lecture	Lecture on the topics of advanced structured rationale	√	√	√	√	√	√	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	5	6		
Continuous Assessment: 100%								
Quizzes/Test(s)	√	√	√	√	√	√	60%	
Assessment of Term Report	√	√	√	√	√	√	40%	
Examination: 0%								
							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)
Quizzes/Test(s)	Ability to describe the underlying principles of alloy design that can be used for developing structural materials like steels, superalloys, nano-structured materials, bulk metallic glasses, refractory materials, and light-weight materials as well as techniques for producing structural gradient alloys along with their applications.	High	Significant	Moderate	Not even reaching marginal levels
Assessment of Term Report	Quality of the report with emphasis on relevant and exhaustive literature review on the topic given towards identifying suitable alloy(s) that can be developed for a given application.	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)
Quizzes/Test(s)	Ability to describe the underlying principles of alloy design that can be used for developing structural materials like steels, superalloys, nano-structured materials, bulk metallic glasses, refractory materials, and light-weight materials as well as techniques for producing structural gradient alloys along with their applications.	High	Significant	Moderate	Basic	Not even reaching marginal levels
Assessment of Term Report	Quality of the report with emphasis on relevant and exhaustive literature review on the topic given towards identifying suitable alloy(s) that can be developed for a given application.	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.)

Phase diagram and microstructural control, hardening of structural materials, conventional and nanostructured steels with high strength, bulk metallic glasses (BMGs): Glass forming ability, atomic structures and mechanical properties, high-temperature superalloys, structural-gradient metallic materials, high-temperature refractory metals and alloys, and light-weight Ti-based alloys (including two-phase TiAl intermetallic 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.)

Nil

2.2 Additional Readings

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

- Atomic structures of bulk metallic alloys (BMGs): Atomic-level structure and structure-property relationship in metallic glasses by Y.Q. Cheng and E. Ma, Progress in Materials Science (2010)
- Recent papers on bulk metallic Glasses by XJ Liu and CT Liu
- Bulk Metallic glasses by C. Suryanarayana and A. Inoue, CRC Publication, 2010
- Superplasticity in Metals and Ceramics by TG Nieh et al., Cambridge University Press, 1991
- Intermetallic compounds as new structural materials by M. Yamaguchi, Elsevier Publication, 1996
- Recent papers on nanostructured ferritic and austenitic steels by CT Liu, MW Chen, MK Miller, ME Fine.
- Recent papers on structural-gradient metallic materials and SMAT materials by Jian Lu
- The superalloys: fundamentals and applications by Rogers C. Reed, Cambridge University Press, 2006