City University of Hong Kong
Course Syllabus

offered by
Department of Mechanical Engineering
with effect from Semester A 2024/25

Part I Course Overview

Course Title:	Mechanical Design with Advanced Material & Additive Manufacturing
Course Code:	MNE5112
Course Duration:	1 semester
Credit Units:	3 credits
Level:	P5*
Medium of Instruction:	English
Medium of Assessment:	English
Prerequisites: *(Course Code and Title)*	Nil
Precursors: *(Course Code and Title)*	MNE2110 Engineering Materials **and** MNE3118 Mechanics of Materials
Equivalent Courses: *(Course Code and Title)*	Nil
Exclusive Courses: *(Course Code and Title)*	Nil

***This course is suitable for engineering senior year students and postgraduate students.**

Part II Course Details

1. Abstract

This course aims to develop an in-depth understanding of integrated mechanical design by considering the incorporation of advanced materials and processing including 3D/4D printing. The objective is for students to learn the methodology of mechanical design with advanced approaches such as new materials and advanced manufacturing processing selection, design with fatigue resistance and structural integrity consideration, and prestressed engineering. The design projects will be introduced with integration of advanced materials such as nanomaterials and 3D/4D printing technology. It will enhance students' skills for analysis, design and implementation of new materials in the mechanical systems for advanced sectors such as aerospace, automotive, smart phone, underwater vehicle, bioimplant and MEMS, etc.

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.	to **describe** the fundamentals of advanced design of mechanical systems by integrating Advanced Materials with Additive Manufacturing (3D/4D printing).		✓	✓	✓
2.	to **design** with material selection and fatigue resistance consideration.		✓	✓	
3.	to **design** with the residual stresses consideration.			✓	✓
4.	to **design** with the advanced materials and Additive Manufacturing (3D/4D printing).			✓	✓
5.	to **adapt** advanced design methods for mechanical components and systems design.			✓	✓
		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 real-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. Learning and Teaching Activities (LTAs)

(LTAs designed to facilitate students' achievement of the CILOs.)

LTA	Brief Description	CILO No.					Hours/week (if applicable)
		1	2	3	4	5	
Lecture	The main teaching activities will be in the form of lectures. The lectures are sometimes broken up with small group activities, during which students work with their neighbors before feeding back the results to the class.	✓	✓	✓	✓	✓	2 hrs/week
Tutorial	Tutorials are problem-solving sessions and are sometimes broken up into small group discussions. The students are invited to realize small projects on different aspects of design, advanced materials manufacturing and 3D/4D printing.	✓	✓	✓	✓	✓	1 hr/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	5		
Continuous Assessment: 60%							
Mini-projects	✓	✓	✓	✓	✓	40%	
Homework	✓	✓	✓	✓	✓	20%	
Examination: 40% (duration: 2 hours)							
Examination	✓	✓	✓	✓	✓	40%	
						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 before Semester A 2022/23 and in Semester A 2024/25 & thereafter

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1. Mini-projects	To test students' understanding of the topics during the course of the lecture through a mini group project.	High	Significant	Moderate	Basic	Not even reaching marginal levels
2. Homework	Pass or fail to see student attitudes and ability.	High	Significant	Moderate	Basic	Not even reaching marginal levels
3. Examination	Written exam at the end of the semester.	High	Significant	Moderate	Basic	Not even reaching marginal levels

Applicable to students admitted from Semester A 2022/23 to Summer Term 2024

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B)	Marginal (B-, C+, C)	Failure (F)
1. Mini-projects	To test students' understanding of the topics during the course of the lecture through a mini group project.	High	Significant	Moderate	Not even reaching marginal levels
2. Homework	Pass or fail to see student attitudes and ability.	High	Significant	Moderate	Not even reaching marginal levels
3. Examination	Written exam at the end of the semester.	High	Significant	Moderate	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.)

Integrated design,
Material selection,
Fatigue design,
Prestressed engineering,
Additive manufacturing,
3D/4D printing

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.)

N.A.

2.2 Additional Readings

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

1.	Michael F. Ashby, Materials Selection in Mechanical Design, 5th Edition, Butterworth-Heinemann, 2016.
2.	S.Suresh, Fatigue of Materials, Cambridge University Press, 1998.
3.	Jian Lu Handbook of Measurement of Residual Stresses, Prentice Hall, 1996.
4.	Jian Lu Handbook on Residual Stresses, 2nd Edition, Vol.1, Residual stress: Manufacturing and Materials Processing, 2006, SEM.
5.	Jian Lu Handbook on Residual Stresses, 2nd Edition, Vol.2, Residual stress and Mechanical Design, 2006, SEM.
6.	Jian Lu et al. : 3D printing of structural materials: MSE-Report 2021, Elsevier.