MNE5112: MECHANICAL DESIGN WITH ADVANCED MATERIAL & ADDITIVE MANUFACTURING

Effective Term
Semester A 2025/26

Part I Course Overview

Course Title
Mechanical Design with Advanced Material & Additive Manufacturing

Subject Code
MNE - Mechanical Engineering
Course Number
5112

Academic Unit
Mechanical Engineering (MNE)

College/School
College of Engineering (EG)

Course Duration
One Semester

Credit Units
3

Level
P5, P6 - Postgraduate Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
Nil

Precursors
MNE2110 Engineering Materials and MNE3118 Mechanics of Materials

Equivalent Courses
Nil

Exclusive Courses
Nil

Additional Information

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

Part II Course Details

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.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	to describe the fundamentals of advanced design of mechanical systems by integrating Advanced Materials with Additive Manufacturing (3D/4D printing).		x	x	x
2	to design with material selection and fatigue resistance consideration.		x	x	
3	to design with the residual stresses consideration.			x	x
4	to design with the advanced materials and Additive Manufacturing (3D/4D printing).			x	x
5	to adapt advanced design methods for mechanical components and systems design.			x	x

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.

Learning and Teaching Activities (LTAs)

	LTAs	Brief Description	CILO No.	Hours/week (if applicable)
1	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.	1, 2, 3, 4, 5	2 hrs/week
2	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, 2, 3, 4, 5	1 hr/week

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks ("-" for nil entry)	Allow Use of GenAI?
1	Mini-projects	1, 2, 3, 4, 5	40	-	Yes
2	Homework	1, 2, 3, 4, 5	20	-	Yes

Continuous Assessment (%)

60

Examination (%)

40

Examination Duration (Hours)

2

Minimum Continuous Assessment Passing Requirement (%)

30

Minimum Examination Passing Requirement (%)

30

Additional Information for ATs

For a student to pass the course, at least 30% of the maximum mark for both coursework and examination should be obtained.

Assessment Rubrics (AR)

Assessment Task

Mini-projects (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

To test students' understanding of the topics during the course of the lecture through a mini group project.

Excellent
(A+, A, A-) High

Good
(B+, B, B-) Significant

Fair
(C+, C, C-) Moderate

Marginal
(D) Basic

Failure
(F) Not even reaching marginal levels

Assessment Task
Homework (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion
Pass or fail to see student attitudes and ability.

Excellent
(A+, A, A-) High

Good
(B+, B, B-) Significant

Fair
(C+, C, C-) Moderate

Marginal
(D) Basic

Failure
(F) Not even reaching marginal levels

Assessment Task
Examination (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion
Written exam at the end of the semester.

Excellent
(A+, A, A-) High

Good
(B+, B, B-) Significant

Fair
(C+, C, C-) Moderate

Marginal
(D) Basic

Failure
(F) Not even reaching marginal levels

Assessment Task
Mini-projects (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
To test students' understanding of the topics during the course of the lecture through a mini group project.

Excellent
(A+, A, A-) High

Good
(B+, B) Significant

Marginal
(B-, C+, C) Moderate

Failure
(F) Not even reaching marginal levels

Assessment Task
Homework (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Pass or fail to see student attitudes and ability.

Excellent
(A+, A, A-) High

Good
(B+, B) Significant

Marginal
(B-, C+, C) Moderate

Failure
(F) Not even reaching marginal levels

Assessment Task
Examination (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Written exam at the end of the semester.

Excellent
(A+, A, A-) High

Good

(B+, B) Significant

Marginal

(B-, C+, C) Moderate

Failure

(F) Not even reaching marginal levels

Part III Other Information

Keyword Syllabus

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

Reading List

Compulsory Readings

	Title
1	Nil

Additional Readings

	Title
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.