

MNE5112: MECHANICAL DESIGN WITH ADVANCED MATERIAL AND ADDITIVE MANUFACTURING

Effective Term

Semester A 2026/27

Part I Course Overview

Course Title

Mechanical Design with Advanced Material and 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

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Failure

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Assessment Task

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

Criterion

Written exam at the end of the semester.

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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.