MNE4208: ADVANCED COMPOSITES AND POLYMERS

Effective Term
Semester A 2022/23

Part I Course Overview

Course Title
Advanced Composites and Polymers

Subject Code
MNE - Mechanical Engineering
Course Number
4208

Academic Unit
Mechanical Engineering (MNE)

College/School
College of Engineering (EG)

Course Duration
One Semester

Credit Units
3

Level
B1, B2, B3, B4 - Bachelor's Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
Nil

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Additional Information
#Prerequisites which are not part of the Major Requirement are waived for students admitted with Advanced Standing.

Part II Course Details

Abstract

The purpose of this course is to introduce students to the field of composite materials and polymers that are playing an ever more increasing role in engineering. The course provides an in-depth study of composite and polymeric materials including mechanical behaviour, failure modes, design and analysis methodologies, manufacturing processes and lay-up formats, Introduction to bio and nano composites. Applications of these materials in the aerospace industry form a central theme throughout the course. The student will be able to develop skills relating to the design and analysis of structures using composite materials.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Understand and describe the basic concepts of composite materials, their advantages and disadvantages and their use in the aerospace industry.			x	
2	To be able to explain what the important design parameters for polymeric composites are and how to use basic principles for the design and analysis of composite structures.			x	
3	To be able to describe the various manufacturing processes and forming technologies of composite materials and how these relate to aerospace requirements.			x	
4	Present results, analyses and conclusions from experiments or simulations in a written report such that a technically qualified person can obtain a clear understanding of the findings.			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.

Teaching and Learning Activities (TLAs)

	TLAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lecture	This includes a combination of lectures and tutorial classes on composites in general and the design, analysis, mechanical behaviour and manufacturing processes involved in the role of composites in the aerospace industry.	1, 2, 3	3 hrs/week
2	Laboratory	Students will carry out exercises to study aspects of a range of composite materials in terms of design and mechanical behaviour. These will be reported in the form of a short and concise technical report.	3, 4	3 hrs/week for 2 weeks

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Test and Assignments	1, 2, 3	20	2-3 assignments to be submitted.
2	Laboratory Reports	3, 4	20	2 reports to be submitted

Continuous Assessment (%)

40

Examination (%)

60

Examination Duration (Hours)

3

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

Test and Assignments

Criterion

To be able to describe the concept of composites with applications in the aerospace industry and to use the fundamental principles for the design and analysis of composite structures.

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
Laboratory Reports

Criterion
Ability to explain the mechanical behaviour of composites including failure modes and processing methodologies.

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

Criterion
Demonstrate an understanding of the principles and methodologies used in the design, analysis and manufacture of composite materials. To be able to apply basic principles to design composite structures.

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

Additional Information for AR

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

Part III Other Information

Keyword Syllabus

Composite materials: their advantages and disadvantages, Mechanical and thermal behaviour of composites and composite laminates, Laminate design: assembly of plies/layers, in and out of plane laminates, isotropic/orthotropic/anisotropic properties, calculation of laminate and ply strains, Failure mechanisms, Micromechanical behaviour of composites, Polymeric materials: types of polymers, thermo-physical properties and structures, processing methodologies and categories of types of materials/fibres/reinforcements: carbon, glass, kevlar, graphene, natural fibres, Introduction to bio and nano composites, Applications in the aerospace industry.

In addition to the examination and in-class test, students are required to learn through collaborative lab sessions in order to improve their understanding on strategic thinking, problem solving, team working processes, the relationships and interactions between the fields of knowledge that they have learnt in this and other courses.

Reading List

Compulsory Readings

	Title
1	An Introduction to Composite Materials, Clyne and Hull, 3rd edition, 2019, CUP.

Additional Readings

	Title
1	Nil