MNE4203: MODELLING AND SIMULATION

Effective Term
Semester A 2022/23

Part I Course Overview

Course Title
Modelling and Simulation

Subject Code
MNE - Mechanical Engineering
Course Number
4203

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

This course introduces the student to the principles and methodologies of modelling and simulation. A range of techniques and computer tools will be employed to model structures and materials in aerospace applications. Students will be taught how to use numerical techniques and commercial packages using a range of case studies and programming using tools such as MATLAB.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Understand the fundamental principles and the process of modelling and simulation to simplify and model real world structures and materials.			x	
2	To be able to use a range of computer tools and numerical techniques to allow the student to model real world systems and to be able to interpret the results in a meaningful way.			x	
3	Demonstrate problem solving skills and derive solutions for tasks linked to the modelling of aerospace structures and materials.			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, tutorial classes and case studies on modelling and simulation for problem solving physical problems linked to aerospace engineering.	1, 2, 3	3 hrs/week

2	Laboratory	Students will carry out exercises to obtain hands-on experience of programming and use of commercial software packages to model physical systems within an aerospace environment. 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 carry out rudimentary programming and use commercial software packages for designing and analysing real world aerospace engineering problems and to interrogate and validate the findings.

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 and interpret the results from computer simulations and to carry out simple programming tasks.

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 fundamental principles and techniques of modelling and computer simulations and to implement the taught techniques, conceive and evaluate physical models.

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

Introduction to the processes of modelling, simulation using eg MATLAB, Introduction to the Finite Element Method, Modelling of beams , spars, plates, box sections, Modelling of composites and metallics, Introduction to Computational Fluid Dynamics, Introduction to Fluid, Heat flow. Finite Difference numerical techniques, An introduction to steady an unsteady CFD, Case studies using FEM and CFD.

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	Computational Modelling of Aircraft and the Environment, volume 2, Aircraft Dynamics, Wiley, 2021.

Additional Readings

	Title
1	Modeling, Identification and Simulation of Dynamical Systems, Van Den Bosch, CRC Press 1994.