MNE4203: MODELLING AND SIMULATION

Effective Term Semester A 2024/25

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

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

Medium of Instruction English

Medium of Assessment English

Prerequisites MNE2109 Engineering Mechanics and MNE3122 Fluid Mechanics

Precursors

Nil

Equivalent Courses Nil

Exclusive Courses Nil

Additional Information

#Prerequisites 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, materials and fluids 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.

	LTAs	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

Learning and Teaching Activities (LTAs)

2	Laboratory	Students will carry	3, 4	3 hrs/week for 2 weeks
		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.		

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 and simulation using e.g., MATLAB
- · Introduction to the Finite Element Method
- · Modelling of beams, spars, plates, and box sections
- · Modelling of composites and metallics
- · Introduction to Computational Fluid Dynamics
- · Introduction to Fluid and 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.