MNE4215: INTRODUCTION TO SPACE SYSTEMS AND MATERIALS

Effective Term
Semester A 2022/23

Part I Course Overview

Course Title
Introduction to Space Systems and Materials

Subject Code
MNE - Mechanical Engineering
Course Number
4215

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 domain of spacecraft and satellite technology. The student will learn the basic principles involved in spacecraft flight and design requirements including instrumentation, power sources, types of launch and propulsion systems, orbits, current materials used in spacecraft, manufacturing processes and how to minimise potential failure in the space environment. The course concludes with typical costs involved in space missions and looks at the trends in future space and satellite materials.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Understand and describe the fundamentals of spacecraft flight, the essential systems that make up the core of spacecraft and satellite technology, the impact of the space environment on the choice of materials and the manufacturing processes involved in space systems.			x	
2	Solve problems related to orbit and attitude design and to the basic design of spacecraft structures for a given mission, to solve problems for propulsion and launch requirements and to be able to analyse potential failure modes.			x	
3	Demonstrate problem solving skills and derive solutions for tasks linked to the modelling and manufacture of spacecraft.			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 the space environment, spacecraft and satellite design, materials and manufacturing and trends in future space technologies.	1, 2, 3	3 hrs/week
2	Laboratory	Students will carry out simulation exercises to study spacecraft systems and materials and 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 carry out studies into the design criteria for spacecraft and space systems, space mechanics, selection of materials, manufacturing processes and inspection technologies.

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 simulation exercises involving spacecraft systems and technologies.

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 and solve problems concerning the design concepts for space flight, the systems involved in spacecraft requirements, attitude and orbit control, material selection, propulsion and launch modelling, the manufacturing technologies used for spacecraft and how to analyse potential failure modes.

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

The Space environment, Space systems design domain requirements, Space Instruments, Power systems, Orbit and Attitude design, Satellite technology, Spacecraft launch and propulsion systems, Space mission environment. Spacecraft materials requirements and selection, Manufacturing technologies for spacecraft, Potential failure modes and prevention/inspection methodologies, Space mission costs and future material/technology requirements.

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	Introduction to Space systems: design and synthesis, M Aguirre, Springer, 2013.

Additional Readings

	Title
1	Materials and Processes for Spacecraft, B Dunn, Springer, 2016.