

MNE3205: FLIGHT MECHANICS

Effective Term

Semester A 2024/25

Part I Course Overview

Course Title

Flight Mechanics

Subject Code

MNE - Mechanical Engineering

Course Number

3205

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

MNE3122 Fluid Mechanics

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 key elements involved in flight mechanics. The loads that an aircraft experiences under steady and dynamic manoeuvres are described and the various mathematical models which govern these manoeuvres are presented. Students will gain an understanding of how to apply and interpret these models together with an appreciation of the way an aircraft responds during flight.

Course Intended Learning Outcomes (CILOs)

CILOs		Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Understand the underlying principles of flight mechanics and the loads that aircraft are exposed to in steady and dynamic manoeuvres.			x	
2	To be able to explain and analyse the equilibrium eg steady/trimmed/balanced load cases and dynamic manoeuvres eg applying some form of control input to the aircraft.			x	
3	Formulate the load models and derive solutions using relevant mathematical models for the appropriate handling qualities.			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.

Learning and Teaching Activities (LTAs)

LTAs		Brief Description	CILO No.	Hours/week (if applicable)
1	Lecture	This includes a combination of lectures and tutorial classes on flight mechanics accompanied by in-class problem solving sessions and case studies.	1, 2, 3	3 hrs/week

2	Laboratory	Students will carry out exercises to understand the loads that a simple rigid aircraft is exposed to and the methods used to provide good handling properties. These will be reported in the form of a short and concise technical report.	3, 4	3 hrs/week for 2 weeks
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Assessment Tasks / Activities (ATs)

ATs		CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Assignments	1, 2, 3	10	2-3 assignments to be submitted.
2	Test	1, 2, 3	10	1 test will be given
3	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 use the different mathematical models for steady and dynamic manoeuvres and assess the performance in terms of stability and response characteristics.

Excellent (A+, A, A-)

75%-100%

Good (B+, B, B-)

60%-74%

Fair (C+, C, C-)

45%-59%

Marginal (D)

40%-44%

Failure (F)

<40%

Assessment Task

Laboratory Reports

Criterion

Ability to explain the methodology and procedures used and analyse the data, discuss the findings with concise conclusions.

Excellent (A+, A, A-)

Strong evidence of critical thinking; good organization, capacity to analyse and synthesize; superior grasp of subject matter; evidence of extensive knowledge of the experimental matters concerned.

Good (B+, B, B-)

Evidence of grasp of subject, some evidence of critical capacity and analytic ability; reasonable understanding of issues; evidence of familiarity with experiment.

Fair (C+, C, C-)

Student who is profiting from the laboratory class; understanding of the subject; ability to develop solutions to concerning the experiment.

Marginal (D)

Sufficient familiarity with the laboratory content to enable the student to move onto other laboratory materials.

Failure (F)

Little evidence of familiarity with the laboratory class materials; weakness in critical and analytic skills; limited, or irrelevant use of data.

Assessment Task

Examination

Criterion

Demonstrate an understanding of the principles of flight mechanics and the loads and input controls used to obtain stability and flight control for equilibrium and dynamic manoeuvres of a rigid aircraft.

Excellent (A+, A, A-)

Strong evidence of original thinking; good organization, capacity to analyse and synthesize; superior grasp of subject matter; evidence of extensive knowledge base.

Good (B+, B, B-)

Strong evidence of original thinking; good organization, capacity to analyse and synthesize; superior grasp of subject matter; evidence of extensive knowledge base.

Fair (C+, C, C-)

Student is profiting from the university experience; understanding of the flight mechanics; ability to develop solutions to simple problems in the course.

Marginal (D)

Basic familiarity with the subject matter to enable the student to progress without repeating the course.

Failure (F)

Little evidence of familiarity with the subject matter; weakness in critical and analytic skills; very limited demonstration of correct use knowledge in flight mechanics.

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**

Equilibrium manoeuvre: aircraft under normal acceleration, load factor, steady pull up and turn, manoeuvre envelope. Dynamic manoeuvre: earth fixed/body fixed axes transformations, outline equations of motion in body fixed axes for a rigid aircraft in 2D (heave and pitch motion), response to transient input in the time domain, transfer functions for elevator input, short period and phugoid stability modes, use of FCS to adjust handling qualities, simplified model of lateral motion.

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	Flight Dynamics Principles: a linear systems approach to aircraft stability and control, M Cook.

Additional Readings

Title	
1	Nil