Flight Dynamics & Control II

Revision Lecture

Contact Information

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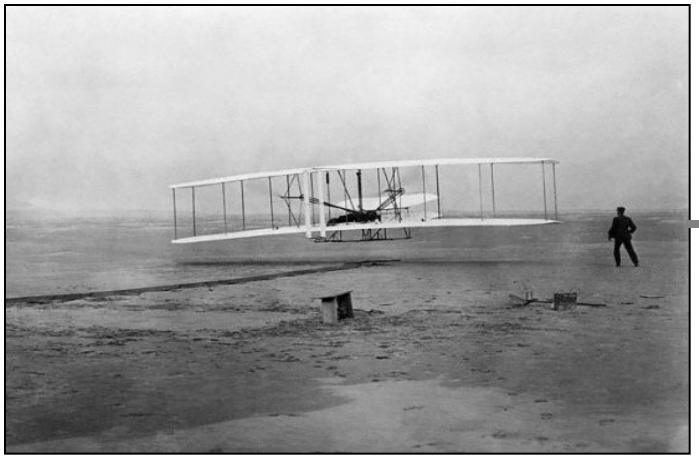

100 years!

Flight Dynamics & Control II

- Multi-degree of freedom systems – Aircraft!
- Methods for predicting principle forces acting on the whole aircraft – e.g. strip theory
- Static flight balance and aircraft stability
- Methods of stability analysis
- Mathematical descriptions of aircraft motions – e.g. phugoid, short period etc…
- Introduction to Control

Lectures

1. General introduction – References
2. Reference axes - Co-ordinate axis system, sign conventions for aircraft motions and control surfaces
3. Control surfaces – definition, effect
4. Strip Theory I
5. Strip Theory II
6. Rigid-body equations I

Lectures

7. Rigid-body equations II
8. Inertial Terms
9. Longitudinal balance
10. Elevator Angle to Trim
11. Static Stability
12. Aircraft Modes
13. Handling Qualities

Lectures

14. Trimming & linearisation – characteristics roots
15. Small Perturbation Equations
16. Introduction to Control

Revision

Course Overview

- The exam itself will be 3 out of 5 questions – *check your timetable*
- 5 questions from the lectures

Course Overview – Lectures

• General Introduction	Lecture 1
• Reference Axes	Lecture 2
• Control Surfaces	Lecture 3

• Strip theory	Lectures 4 & 5

- Be able to develop from first principles the application of strip theory, e.g, as shown in the rolling power response
- I will expect you to be happy applying strip theory to both the lateral and longitudinal cases.
- Forces & moments – main aerodynamic surfaces

Course Overview – Lectures

• Rigid-body equations	Lectures 6 & 7
• Inertias	Lecture 8

- You need to be happy with the nomenclature, reference axes and the basic principles of inertia and coupling. Be able to explain the nature of inertial coupling relative to a standard aircraft configuration.
- You will not be expected to derive or remember the rigid body equations as shown in Lecture 6 & 7.

Course Overview – Lectures

• Longitudinal balance	Lectures 9
• Elevator Angle to Trim	Lecture 10
• Static stability	Lecture 11

- Be happy with developing the equations for longitudinal balance, up to and including the example giving tail lift.
- You will not be expected to remember the models for downwash.
- Understand what is meant by flight balance and the equations to find the trimmed elevator angle.
- In Lecture 11 be able to define the neutral point and static margin and the implication of the requirement for static stability. The effect of CG movement.
- Understand and be able to relate the change in pitching moment to static stability. Be able to develop the equation relating pitching moment to change in attitude. M vs. α.

Course Overview – Lectures

• Aircraft Modes	Lecture 12
• Handling Qualities	Lecture 13
• Trimming & Linearisation	Lecture 14
• Small Perturbation Equations	Lecture 15

- Recognise and be able to describe the typical longitudinal and lateral modes. You will not be expected to derive or remember the equations of motion but will be expected to recognise, describe and use the standard form shown.
- You will be expected to be able to relate the characteristic root positions on the complex plane to typical aircraft response modes (inc. freq. & damping). Handling qualities – e.g. short period.
- You will be expected to be able to find the approximate solution to the equations and to be able to find the approximate equations (e.g. for the short period mode). This applies to both the longitudinal and lateral equations.

Exam

- The equations are not enough!
- Use diagrams wherever possible
- Talk through the implications of the equations if needed
- Write down all your assumptions
- Part of the questions requires you to think through the problem – not all the answers are expected to be just recall!
- List all the terms and notation you use
- Be careful with the simple calculations
- Explain your approach

Flight Dynamics and Control

References

Flight Dynamics Principles – Book References for Lecture Topics

- These are intended for further reading and to support the in-class lecture material.
- In many places, this book goes beyond the scope of the course – so I have highlighted the areas that I think are most relevant for each topic.
- If in doubt as to whether a topic needs to be covered, the lectures notes on blackboard take precedence.
- Note: some of the nomenclature and derivations differ from those we used in lectures.
- These references are for the 2007 edition.
  - *Flight Dynamics Principles: A Linear Systems Approach to Aircraft Stability and Control (Elsevier Aerospace Engineering) Hardcover – 9 Aug 2007*

- General introduction – References
  - Nomenclature
  - The whole of Chapter 1 – Introduction
- Reference axes - Co-ordinate axis system, sign conventions for aircraft motions and control surfaces & Control surfaces – definition, effect
  - The whole of Chapter 2 including the problem section
- Strip Theory
  - Section 13.1 (Chapter 13)
  - Section 13.4 (Chapter 13)
- Rigid-body equations
  - Section 4.1 (Chapter 4)

- Longitudinal balance, Static Stability & Elevator Angle to Trim
  - Chapter 3 – up until the end of 3.62
  - Chapter 3 problems

- Aircraft Modes & Handling Qualities
  - Sections 6.1, 6.2 and 6.3
  - Problems 1 & 2, Chapter 6
  - Sections 7.1, 7.2 & 7.3
  - Problems 1, 2, 3 & 4, Chapter 7
  - Section 9.4 & 9.5
  - Sections 10.1-10.6
  - Sections 10.8 & 10.9
  - Problems 1, 2 and 4, Chapter 10

Trimming & linearisation – characteristics roots & Small Perturbation Equations
  - Sections 4.2 & 4.3
  - Problems 3 & 4, Chapter 4

Introduction to Control
  - Sections 11.1 and 11.2
  - Problems 1 & 2, Chapter 11

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