Definitive Module Document (DMD)

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Module Code:3AAD0017

Title of Module
Full Title: Aerospace Performance, Propulsion & Design
Short Title: Aero Perf, Prop & De

MODULE

3AAD0017 (A 05/6)

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Version: 1

Credit Points: 30

Level / ECTS Level: 3

First Offered: 1/9/2004 00-00-00

6. Home Department:
AAD

7. Departments(s) contributing to teaching:

9. Module Aims:

* develop an in-depth understanding of the theory and practices associated with the design and performance analysis of aircraft and their propulsion devices.

* be introduced to the fundamentals of rocket performance and satellite dynamics.

* experience the process of producing preliminary designs for a whole aircraft through group activity.

* develop a professional attitude and critical approach to the application of engineering knowledge and skills.

10a. Learning Outcomes: Knowledge and Understanding:

* identify the design and operational factors governing the performance of an aircraft

* recognise the relationship between the design and performance of gas turbine engine components.

* show an awareness of the principal regulatory requirements on the design of aircraft

* demonstrate a detailed understanding of one major area of aircraft design

10b. Learning Outcomes: Skills and Attributes:

* perform calculations necessary to assess an aircraft's performance

* analyse and optimise the performance of multi-stage rockets. Analyse satellite orbital motions.

* analyse the performance of an aircraft gas turbine engine and its prime components

* apply conduction, convection and radiation heat transfer algorithms to solve thermal analysis problems

* make an effective and sustained contribution to the working of a design team

* select appropriate materials, processes and bought-out components and systems appropriate to a major aircraft structure

* show an ability to work within constraints such as cost, weight and performance requirements

* contribute to a seminar presentation of major work areas undertaken

11. Module Content
11a Module Content:
Performance

1. Atmosphere properties and air speed definitions

2. Straight and level flight

3. Range

4. Climbing flight

5. Accelerated flight

6. Standardised performance

7. Single and multi-stage rocket performance; satellite orbital dynamics

Propulsion

1. Development and variants of gas turbine engines

2. Gas turbine component design and performance characteristics. Intakes; axial & centrifugal compressors; combustion chambers; turbines; exhaust systems; engine systems

3. Gas turbine performance

a. Design point

b. Off-design

4. Principles of conduction, convection & radiation heat transfer

Design

As part of a small group, undertake the design of a complete aircraft to meet a given specification. Each member will fulfil a distinct role, and will contribute to the progress of the team. By the end of the course, the team will produce a detailed technical report and a seminar presentation.

11b. Further details on how the learning outcomes of the module will be achieved:
Performance

1. International standard atmosphere, speed measurement, TAS and EAS.

2. Straight and level flight. the drag polar, minimum power and drag conditions, flight envelope.

3. Climb rate prediction. Simplifying assumptions; conditions for maximum climb rate and climb angle; time to height; acceleration effects; energy height method.

4. Range prediction; Breguet range equations; conditions for maximum range.

5. Accelerated flight; take-off and landing performance.

6. Standardised performance; application to range optimisation.

7. Single and multi-stage rocket performance; benefits of multi-staging; launcher optimisation.

8. Satellite dynamics. The two-body problem; the Hohmann transfer; orbit inclination changes

Propulsion

1. Development and variants of gas turbine engines

2. Gas turbine component design and performance characteristics.

a. Intakes (subsonic & supersonic)

b. Axial & centrifugal compressors (including velocity diagrams)

c. Combustion chambers

d. Turbines (including velocity diagrams)

e. Exhaust systems (nozzles, thrust reversers & reheat)

f. Engine systems (air, oil, thermal)

3. Gas turbine performance

a. Design point (including full engine performance cycle syntheses)

b. Off-design (altitude, AIT, aircraft speed)

4. Principles of conduction, convection & radiation heat transfer

a. Practical heat transfer problem solving

Design

Each group will comprise a number of students each with responsibility for a particular aspect of the overall design (e.g. wing design, undercarriage design). Additional duties may be required during the project, to meet the overall objectives.

Typically, projects will include-

1. Market trends, costs and legal requirements

2. aircraft configuration, aerodynamics and performance

3. engine selection, performance, installation, services

4. structural design of primary aircraft components

5. aircraft systems, including control systems, electrical and hydraulic supplies, mission-specific equipment

12. Language of Delivery:
English

13. Language of Assessment:
English

14. Assessment Details (Academic):
Coursework: 70

Exam: 30

Other: Typically, assessment will consist of-

One 3-hour end-of-course examination (30%)

One piece of performance coursework (6%)

One piece of propulsion coursework (6%)

One performance and propulsion phase test (8%)

Design project peer phase assessments, seminar presentation and report (50%)

Design project seminar presentations (10%)

Design project report (16%)

Assessment Notes:
Separate passes are required in both the coursework and examination elements of assessment

15. Locations(s):
UH HATFIELD

16. Pre and Co-Requisite:
Pre-Requisite

Co-Req

Prohibited

17. Subject Board of Examiner/s:

AERO/CIVIL/MECH ENG L2/3

18. Comments