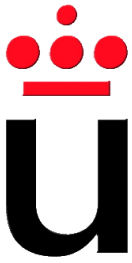

Universidad
Rey Juan Carlos

DEGREE IN AEROSPACE ENGINEERING IN AIR NAVIGATION

Collection of Assignments
Course on Aerospace Engineering

Academic year 2012/2013

Manuel Soler Arnedo
January, 2013.

Contents

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Assignment I: Oral exposition

The assignment will consist of an oral exposition. The students will be grouped in different work groups formed by 5-6 people each. Each group will be assigned documentation (see blibliography). The students should read the documentation, discuss the gathered information and structure it as a presentation. The presentation will be submitted. One of the members of the group will expose the presentation to the class.

Goals and competences:

- Acquire ability to read technical documents.
- Acquire abilities to work in teams, discuss and synthesize the information.
- Acquire abilities to structure the information in a slide presentation format.
- Acquire abilities to communicate effectively.
- Acquire general knowledge on aerospace engineering related disciplines.

Constraints:

- The member of the team to expose the presentation will be chosen randomly by the lecturer. This means the whole group must work together and all members must practice in front of their colleagues.
- The presentation should last around 7 minutes, never more than 8 minutes.
- The session chair (the lecturer) will allow a round of questions after the presentation.

Recommendations:

- Use any of the slide editors (Power point, Keynote, etc).
- A presentation should contain visual power data, such for instance, figures, different colors, bold letter, itemizes, etc.
- The number of slides of the presentation should be adapted to the given time. Control the time when practicing.

- Do not write long sentences, write short statements.
- Use pauses to synchronize the presentation with what your are telling and keep audience attention.
- Try not to simply read what it is stated on the slides.
- Do not try to learn by heart the whole speech. At some point you will get stuck. It is better to understand what you want to say and simply communicate it.
- The communication should motivate the audience, it should be given with the proper tone of voice trying to generate interest in the audience.

Evaluation

The evaluator will consider:

- Quality of the content of the presentation (around 50%).
- Quality of the oral communication (around 40%).
- Capacity of assessing the questions (around 10%).

Administrative issues:

- Assignment date: January the 15th, 2013; Tuesday.
- Presentation submission (only pdf allowed): until 12:00 of January the 22nd, 2013; Tuesday.
- Exposition date: January the 22nd, 2013; Tuesday: 15:00–17:00.

The documents to be used in these assignment are: [1] [2] [3] [4] [5] [6, 7, 8]

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Assignment 2: Scientific memory. ISA atmosphere

The assignment consists of:

- Deduce the equations of the International Standard Atmosphere (ISA) in the troposphere $(0 \leq h < 11000\ [m])$:
  - Expose the considered hypotheses.
  - Deduce the equations.
- Obtain the pressure, temperature and density on top of Mount Everest (Altitude 8848 m; longitude $87.30°$East; latitude $27.8°$North).
- Deduce the equations of the International Standard Atmosphere (ISA) in the lower stratosphere $(11000 \leq h < 20000\ [m])$:
  - Expose the considered hypothesis.
  - Deduce the equations.
- Consider and aircraft flying at $h = 2000$ m over Spain whose destination airport is Madrid Barajas. The reference altitude of the airport is $h_{MB} = 610$ m. The aircraft has an on-board barometric altimeter which continuously measures the pressure of air. In particular, the last measured pressure is $P_{A_{measured}} = 79600$ Pa. At the same time, the pressure at the airport is measured yielding $P_{MB_{measured}} = 94250$ Pa. According to the different settings, namely QNE, QNH, QFE, obtain the barometric altitude. Analyze the observed errors.

The students are allowed to be grouped in work groups formed by 3 people each. A scientific memory should be completed and submitted in time and form.

Goals and competences:

- Understanding of the scientific method: make hypotheses; deduce equations derived from that hypotheses; compare results.
- Acquire abilities to work in teams, discuss and reach to conclusions.
- Acquire abilities to write scientific documents.
- Understanding the characteristics of the atmosphere.

Constraints:

- There is not limitation on the number of pages.

Recommendations:

- Use any of the available text editors, for instance Microsoft Word. However, it is strongly recommended to use Latex.
- A scientific memory should asses a scientific issue with rigor, the expected audience are scientists, so you must write as an expert on the topic.
- Use figures and tables when you consider that helps the comprehension.
- A scientific memory should contain a bibliography with all the relevant references (Typically they do not contain an index of contents, a list of tables, nor a list of figures).
- All used references should be cited properly.
- A scientific memory should be properly structured in sections and subsections. In particular, It should start with an introduction motivating the topic. Then, state the model subject of study with all the assumptions and hypotheses. In particular, expose all hypotheses in a clear manner. Expose the results also in a clear manner and discuss them. Close up with some conclusions.
- Label all equations and referred to them (cross-reference) when required.
- When deducing equations, expose step by step what you have done.

Evaluation

The evaluator will consider:

- Quality of the content of the scientific memory (around 60%).
- Originality of the work (around 40%).

Administrative issues:

- Assignment date: January the 29th, 2013; Tuesday.
- Report submission (only pdf allowed): February the 5th, 2013; Tuesday.

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Assignment 3: Scientific discussion. Aerodynamics

The assignment consists of assessing the following question:

- **How lift is produced**:

The students are allowed to team up in work groups formed by 3-4 people each. The memory should be completed and submitted in time and form.

Goals and competences:

- Acquire abilities to work in teams, discuss and reach to conclusions.
- Acquire abilities to write scientific documents.
- Understanding the phenomenology of lift.

Constraints:

- There is NO limitation on the number of pages.

Recommendations:

- Try to describe the different explanations and discuss them. In particular discuss the circulation theory of lift. **Check** [9, **Chapters 4,5**]. Choose the most appropriate for in depth exposition.
- The written style should be that of a scientific memory. **Double check Assignment 3 recommendations for more information**. In particular, state the main hypothesis needed for the formulation and deduce the needed equations. Use sketches whenever necessary to illustrate or point out your considerations.

Evaluation

The evaluator will consider:

- Quality of the content of the scientific memory (around 60%).
- Originality of the work (around 40%).

Administrative issues:

- Assignment date: January the 31st, 2013; Thursday.
- Submission (only pdf allowed): February the 8th, 2013; Friday.

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Assignment 4: Mechanics of flight

The assignment consists of:

- **Deducing the 3DOF equations that govern the motion of an aircraft**.
- **Define all the involved variables and the references in which the equations are expressed**.

The student should reach to the following ODE system:

$$
\begin{aligned}
m\dot{V} &= T - D - mg\sin\gamma; && \text{(4.1a)}\\
mV\dot{\chi}\cos\gamma &= L\sin\mu; && \text{(4.1b)}\\
mV\dot{\gamma} &= L\cos\mu - mg\cos\gamma; && \text{(4.1c)}\\
\dot{x_e} &= V\cos\gamma\cos\chi + W_x; && \text{(4.1d)}\\
\dot{y_e} &= V\cos\gamma\sin\chi + W_y; && \text{(4.1e)}\\
\dot{h_e} &= V\sin\gamma; && \text{(4.1f)}\\
\dot{m} &= -T\eta. && \text{(4.1g)}
\end{aligned}
$$

In order to reach to System (4.1), the student should:

- Define the different reference frames
- Deduce the orientation matrix between different reference frames using Euler rotations.
- State the general (6DOF) equations of motion.
- Analyze the different forces acting on an aircraft.
- State the mass relations, the kinematic relations and the angular relations.

The students are allowed to team up in work groups formed by 3-4 people each. The memory should be completed and submitted in time and form.

Goals and competences:

- Acquire abilities to work in teams, discuss and reach to conclusions.
- Acquire abilities to write scientific documents.
- Acquire abilities to do mathematical operations.
- Understanding the phenomenology of flight mechanics.

Constraints:

- There is NO limitation on the number of pages.

Recommendations:

- The student is encourage to consult the Appendix A: Mechanics of flight of the course lecture notes.
- The written style should be that of a scientific memory. **Double check Assignment 2 recommendations for more information**. In particular, state the main hypothesis needed for the formulation and deduce the needed equations.

Evaluation

The evaluator will consider:

- Quality of the content of the scientific memory (around 80%).
- Originality of the work (around 20%).

Administrative issues:

- Assignment date: March the 5th, 2013; Tuesday.
- Submission (only pdf allowed): March the 12th, 2012; Tuesday.

Bibliography

[1] L. Navarro, *Descubrir el transporte aéreo*. Centro de Documentación y Publicaciones de AENA, 2003.

[2] J. Ontiveros, *Descubrir el control aéreo*. Centro de Documentación y Publicaciones de AENA, 2003.

[3] J. Martinez Cabeza, *Descubrir la industria aeronáutica*. Centro de Documentación y Publicaciones Aena, 2005.

[4] A. Benito, *Discover airline companies*. Centro de Documentación y Publicaciones Aena, 2008.

[5] M. García Cruzado, *Descubrir la operación de aeropuertos*. Centro de Documentación y Publicaciones Aena, 2008.

[6] I. Ascacíbar, *Descubrir las aeronaves, segunda edición*. Centro de Documentación y Publicaciones Aena, 2003.

[7] F. Saéz Nieto and Y. Portillo, *Descubrir la navegación aérea*. Centro de Documentación y Publicaciones Aena, 2003.

[8] I. Anguiano, *Discover airports*. Centro de Documentación y Publicaciones de Aena, 2002.

[9] J. Anderson, *Introduction to flight, seventh edition*. McGraw-Hill, 2012.