Course guide
220034 - SH - Hydraulic Systems

Unit in charge: Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 729 - MF - Department of Fluid Mechanics.
Degree: BACHELOR'S DEGREE IN AEROSPACE VEHICLE ENGINEERING (Syllabus 2010). (Compulsory subject).
Academic year: 2022  ECTS Credits: 4.5  Languages: Catalan

LECTURER
Coordinate lecturer: Salvador de las Heras
Others: Hipòlit Moreno - Francisco Arias

REQUIREMENTS
It is considered essential to have passed the subject of Fluid Mechanics.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONtributes
Specific:
CE24. GrEVA - An adequate understanding of the following, as applied to engineering: aircraft systems and automatic flight control systems in aerospace vehicles.

Transversal:
07 AAT N3. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.

TEACHING METHODOLOGY
- Lecture presenting the contents.
- Practical work.
- Independent work and study exercises.
- Preparation and assessable activities in groups.
LEARNING OBJECTIVES OF THE SUBJECT

After completing the course, students must have achieved Level 3 (application) with general learning objectives:

Technology in the field of specialty
- Understand the scientific foundations
- Know how to use the technology and the necessary engineering

Professional performance
- Analyze specific situations, define problems, make decisions and implement plans of action in the search for solutions.
- Apply knowledge to real situations, managing resources appropriately.
- Interpret studies, reports, and analyze data numerically.
- Select and manage the information sources.
- Use existing tools as support.
- Working in a multidisciplinary team.
- Evaluate the integral, personal motivation, mobility.

Communication
- Understand and speak with the proper terminology.
- Discuss and argue on various forums.

Technology transfer.
- Analyze and evaluate the environmental, social and ethical profession.
- Have a critical and innovative spirit.
- Retraining in new technological developments through continuous learning.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours large group</td>
<td>31.0</td>
<td>27.56</td>
</tr>
<tr>
<td>Hours small group</td>
<td>14.0</td>
<td>12.44</td>
</tr>
<tr>
<td>Self study</td>
<td>67.5</td>
<td>60.00</td>
</tr>
</tbody>
</table>

Total learning time: 112.5 h

CONTENTS

Module 1: INTRODUCTION TO THE HYDRAULIC SYSTEMS

Description:
1.1. Energy transfer systems (STE)
1.2. STE by fluids (STEF)
1.3. Fluid (types, classification, properties, etc.)
1.4. Pros and cons of the STEF

Related activities:
A - Autotests
C1 - Controls
E - Application Exercises
EP1 - First exam

Full-or-part-time: 18h 30m
Theory classes: 6h
Laboratory classes: 2h
Self study: 10h 30m
### Module 2: COMPONENTS OF A STEF

**Description:**
- 2.1. Conceptual scheme of a STEF
- 2.2. Pumps
- 2.3. Actuators: rotary and linear motors motors (cylinders)
- 2.4. Control elements (valves)
- 2.5. Fluid conditioning elements

**Related activities:**
- A - Autotests
- C1 - Controls
- E - Application Exercises
- EP1 - First exam

**Full-or-part-time:** 40h
- Theory classes: 10h
- Laboratory classes: 6h
- Self study: 24h

### Module 4: SERVO HYDRAULIC VALVES AND DRIVE

**Description:**
- 4.1. Control Type
- 4.2. Servo and proportional valves
- 4.3. Servo valves / hydraulic cylinder
- 4.4. Applications (spoiler control, etc.)

**Related activities:**
- A - Autotests
- C2 - Controls
- E - Application Exercises
- EP2 - Second exam

**Full-or-part-time:** 38h
- Theory classes: 10h
- Laboratory classes: 4h
- Self study: 24h

### Module 5: LANDING GEAR

**Description:**
- 5.1. Landing gears
- 5.2. Hydraulic / pneumatic systems
- 5.3. Design criteria

**Related activities:**
- A - Autotests
- C2 - Controls
- E - Application Exercises
- EP1 - First exam
- EP2 - Second exam

**Full-or-part-time:** 16h
- Theory classes: 5h
- Laboratory classes: 2h
- Self study: 9h
### ACTIVITIES

#### T - THEORY LESSONS

<table>
<thead>
<tr>
<th>Full-or-part-time:</th>
<th>44h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes:</td>
<td>25h</td>
</tr>
<tr>
<td>Self study:</td>
<td>19h</td>
</tr>
</tbody>
</table>

#### ACTIVITY 1: A - AUTOTESTS

**Description:**
Evaluable autotests of 60 minutes to make as individual self-learning.

**Specific objectives:**
Acquiring the ability to know, understand and apply knowledge of the basic principles of the modules / topics, individual work and time management.

**Material:**
Questionnaires in ATENEA

**Delivery:**
Activity assessable where the note is within 10% of the rating system of the subject.

<table>
<thead>
<tr>
<th>Full-or-part-time:</th>
<th>18h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self study:</td>
<td>18h</td>
</tr>
</tbody>
</table>

#### ACTIVITY 2: C1 - CONTROL

**Description:**
Controls multiple choice evaluable 45 minutes to hours of theory and / or Individual problems where in groups of 2 people.

**Specific objectives:**
Acquiring the ability to know, understand and apply knowledge of the basic principles of the modules / topics, individual or team work and time management. Upon completion of this activity, the student should be able to:
- Demonstrate the achievement of specific objectives related to the content of modules 1, 2 and 3

**Material:**
Formula sheet done by the students themselves on one side of A4 paper.

**Delivery:**
Activity assessable where the note is within 10% of the rating system of the subject.

<table>
<thead>
<tr>
<th>Full-or-part-time:</th>
<th>4h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes:</td>
<td>1h</td>
</tr>
<tr>
<td>Self study:</td>
<td>3h</td>
</tr>
</tbody>
</table>
ACTIVITY 3: C2 - CONTROL

Description:
Controls multiple choice evaluable 45 minutes to hours of theory and / or Individual problems where in groups of 2 people.

Specific objectives:
Acquiring the ability to know, understand and apply knowledge of the basic principles of the modules / topics, individual or team work and time management. Upon completion of this activity, the student should be able to:
- Demonstrate the achievement of specific objectives related to the content of modules 4 and 5

Material:
Formula sheet done by the students themselves on one side of A4 paper.

Delivery:
Activity assessable where the note is within 10% of the rating system of the subject.

Full-or-part-time: 4h
Theory classes: 1h
Self study: 3h

ACTIVITY 4: E - APPLICATION EXERCISES

Description:
Application exercises (example of application), summaries of reading articles, book chapters, book report, summary of attendance at seminars and / or conferences. proposed by the / the teacher / s.

Specific objectives:
Promote the implementation of the contents of the subject.

Material:
Collection of problems of the subject hanging in ATHENA. It can also be considered supplemental material.

Delivery:
Activity deliverable. A portion of the generated application exercises and others will be self-assessors note no note value. The part with note shall be within 10% of the rating system of the subject.

Full-or-part-time: 24h
Laboratory classes: 14h
Self study: 10h

ACTIVITY 5: EP - FIRST EXAM

Description:
Exam to do individually.

Specific objectives:
Upon completion of this activity, the student should be able to:
- Demonstrate the achievement of specific objectives related to the content of modules 1, 2 and 4

Material:
Formula sheet used in controls.

Delivery:
The test is 30% of the final grade and will be the date, time and scheduled classroom. Deliver the final test time devoted to the activity.

Full-or-part-time: 8h 30m
Theory classes: 2h
Self study: 6h 30m
EF - SECOND EXAM

Description:
Exam to do individually.

Specific objectives:
Upon completion of this activity, the student should be able to:
- Demonstrate the achievement of specific objectives related to the content of moduls 1, 2, 3 and 4.

Material:
Formula sheet used in controls.

Delivery:
The test is 30% of the final grade and will be the date, time and scheduled classroom. Deliver the final test time devoted to the activity.

Full-or-part-time: 10h
Theory classes: 2h
Self study: 8h

GRADING SYSTEM

- 1st Evaluation: midterm exam, weight: 30% (with the possibility of recovery test midterm)
- 2nd Evaluation: final exam, weight: 30%
- Controls (Type test hours of class theory and / or problems): 20%
- Autotests (type self-test individual)): 10%
- Practical exercises (proposed real applications, reading articles, chapters reading books, attending seminars and / or conferences, etc.): 10%

EXAMINATION RULES.

Individual autotests as independent learning.
Controls are multiple choice and will individually or in pairs with an approximate duration of 45 minutes. A formula sheet can be handmade form by students.
The exams consist of two exercises lasting approximately two hours.

BIBLIOGRAPHY

Basic:

Complementary: