220025 - EA - Aerospace Structures

Coordinating unit: 205 - ESEIAAT - Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 748 - FIS - Department of Physics
737 - RMEE - Department of Strength of Materials and Structural Engineering

Academic year: 2019
Degree: BACHELOR'S DEGREE IN AEROSPACE TECHNOLOGY ENGINEERING (Syllabus 2010). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN AEROSPACE VEHICLE ENGINEERING (Syllabus 2010). (Teaching unit Compulsory)
ECTS credits: 7,5
Teaching languages: Catalan, Spanish

Teaching staff
Coordinator: JUAN CARLOS CANTE TERAN
LLUIS GIL ESPERT
Others: LLUIS GIL ESPERT

Prior skills
The student must have solid knowledge of algebra, infinitesimal calculus and basic physics. Knowledge of elasticity, strength of materials and structures.

Requirements
For the correct use of the subject is recommended to have studied Physics I, II and III, Mechanics and Theory of structures.

Degree competences to which the subject contributes
Specific:
1. GrETA/GrEVA - An understanding of the behaviour of structures under stress in ordinary and extreme conditions.

Teaching methodology
The methodology is divided into three parts:
- Attendance lessons of exposition of the contents.
- Attendance lessons of practical work, including exercises and problems.
- Attendance evaluable sessions of practical work.
During the exposition sessions, the teacher will introduce the theoretical basis of the subject, concepts, methods and results, along with practical examples in order to easy its comprehension.
In the practical work lessons, the teacher will guide the student into the application of the theoretical concepts to solve problems. Exercises will be proposed to solve at and outside the class, to stimulate the contact and use of the basic tools that are necessary to solve the problems.
In the evaluable sessions, the student will solve a problem, using the teaching sinews. The students will have to work autonomously, following the contents explained during the curs.

Learning objectives of the subject
Introduction to the typology of aerospace structures and the detection of loads. Simplified analysis of semimonocoasque structures. Determination of stresses, limit resistance and ultimate (including nonlinear effects). Introduction to fracture mechanics.

**Study load**

<table>
<thead>
<tr>
<th>Total learning time: 187h 30m</th>
<th>Hours large group:</th>
<th>61h</th>
<th>32.53%</th>
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<tbody>
<tr>
<td></td>
<td>Hours medium group:</td>
<td>14h</td>
<td>7.47%</td>
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<tr>
<td></td>
<td>Hours small group:</td>
<td>0h</td>
<td>0.00%</td>
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<tr>
<td></td>
<td>Self study:</td>
<td>112h 30m</td>
<td>60.00%</td>
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### Content

<table>
<thead>
<tr>
<th>Module 1 - Overview of previous concepts of rational mechanics and material resistance.</th>
<th>Learning time: 20h</th>
</tr>
</thead>
</table>
| **Description:** | **Theory classes:** 8h  
**Practical classes:** 2h  
**Self study:** 10h |
| · Review of elementary concepts of kinematics and dynamics of point and rigid solid. Relative kinematics and inertial loads.  
· Fundamentals of elasticity. Tension and strain tensors. Addresses and main values. Isotropic linear elastic material.  
· Fundamentals of resistance of materials. Internal action diagrams. | |
| **Related activities:** | |
| · Theory classes (Ac. 1)  
· Exercise practical exercises individually to assess the mastery of the previous concepts necessary for the proper use of the subject. These exercises will be evaluated and will contribute to the final mark of the subject (Ac. 2) | |

<table>
<thead>
<tr>
<th>Module 2 - Thin-wall sections.</th>
<th>Learning time: 73h 45m</th>
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</table>
| **Description:** | **Theory classes:** 22h 30m  
**Practical classes:** 5h  
**Self study:** 46h 15m |
· Permissible simplifications in the analysis of thin wall structures. Idealization of the structure in cutting panels and traction cords.  
· Thin wall sections subjected to axial, cutting, bending and twisting loads.  
· Introduction to the final dimensioning of reinforced panels. Crippling | |
| **Related activities:** | |
| · Theory classes (Ac. 1)  
· Doing exercises that cannot be evaluated in groups so that students are familiar with the concepts exposed to the theory classes (Ac. 3)  
· Laboratory practices (Ac. 4)  
· Partial examination (Ac. 5) | |
### Module 3 - Elastic instability of structures

**Learning time:** 49h  
- Theory classes: 15h  
- Practical classes: 4h  
- Self study: 30h

**Description:**  
- Linear bifurcation analysis. Matrix analysis.  
- Instability of plates and sheets.  
- Other types of instability

**Related activities:**  
- Theory classes (Ac. 1)  
- Doing exercises that cannot be evaluated in groups so that the students become familiar with the concepts presented in the theoretical classes (Ac. 3)  
- Exercise practical exercises individually to assess the mastery of the concepts necessary for the proper use of the subject. These exercises will be evaluated and will contribute to the final grade of the subject (Ac. 2)  
- Laboratory practices (Ac. 4)  
- Final exam (Ac. 6)

### Module 4 - Plastic calculus

**Learning time:** 27h  
- Theory classes: 10h  
- Practical classes: 2h  
- Self study: 15h

**Description:**  
- Analysis of beams and porches.  
- Analysis of plates.

**Related activities:**  
- Theory classes (Ac. 1)  
- Doing exercises that cannot be evaluated in groups so that the students become familiar with the concepts presented in the theoretical classes (Ac. 3)  
- Exercise practical exercises individually to assess the mastery of the concepts necessary for the proper use of the subject. These exercises will be evaluated and will contribute to the final grade of the subject (Ac. 2)  
- Laboratory practices (Ac. 4)  
- Final exam (Ac. 6)
### Module 5 - Fracture mechanics.

**Learning time:** 17h 45m
- Theory classes: 5h 30m
- Practical classes: 1h
- Self study: 11h 15m

<table>
<thead>
<tr>
<th align="left">Description:</th>
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<tbody>
<tr>
<td align="left">- Introduction. Fragile and ductile break.</td>
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<td align="left">- Fatigue</td>
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<table>
<thead>
<tr>
<th align="left">Related activities:</th>
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<tr>
<td align="left">- Theory classes (Ac. 1)</td>
</tr>
<tr>
<td align="left">- Doing exercises that cannot be evaluated in groups so that the students become familiar with the concepts presented in the theoretical classes (Ac. 3)</td>
</tr>
<tr>
<td align="left">- Exercise practical exercises individually to assess the mastery of the concepts necessary for the proper use of the subject. These exercises will be evaluated and will contribute to the final grade of the subject (Ac. 2)</td>
</tr>
<tr>
<td align="left">- Final exam (Ac. 6)</td>
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</table>
### Planning of activities

| ACTIVITY 1: THEORY SESSIONS | Hours: 162h  
Theory classes: 56h  
Self study: 106h |
<table>
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<tbody>
<tr>
<td><strong>Description:</strong> Large group sessions where the contents of the various modules of the subject will be introduced.</td>
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<tr>
<td><strong>Support materials:</strong> Recommended bibliography of the subject and collections of practical examples solved available on the web of the subject.</td>
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<tr>
<td><strong>Descriptions of the assignments due and their relation to the assessment:</strong> The evaluation of the use of theoretical lessons will be carried out in activities 2 and 5.</td>
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<tr>
<td><strong>Specific objectives:</strong> Explain the theoretical foundations of the subject and prepare students for the activities 2, 3, 4 and 5.</td>
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| ACTIVITY 2: ASSESSED EXERCISES | Hours: 4h  
Practical classes: 4h |
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<tbody>
<tr>
<td><strong>Description:</strong> Exercises individually in medium group sessions that serve to consolidate the teachings of the subject</td>
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<tr>
<td><strong>Support materials:</strong> Recommended bibliography of the subject and collections of practical examples solved available on the web of the subject</td>
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</tr>
<tr>
<td><strong>Descriptions of the assignments due and their relation to the assessment:</strong> The exercises will be scored and contribute to the final grade of the course (20%)</td>
<td></td>
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<tr>
<td><strong>Specific objectives:</strong> Allow the student to evaluate their level of preparation in the contents of the subject.</td>
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| ACTIVITY 3: NOT ASSESSED PRACTICAL EXERCISES | Hours: 7h  
Practical classes: 7h |
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<tbody>
<tr>
<td><strong>Description:</strong> Exercises in medium group sessions that serve to establish the contents of the theoretical classes.</td>
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<tr>
<td><strong>Support materials:</strong> Class notes and recommended bibliography of the subject.</td>
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<tr>
<td><strong>Descriptions of the assignments due and their relation to the assessment:</strong> The exercises serve as preparation for the completion of the exams of the subject.</td>
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<tr>
<td><strong>Specific objectives:</strong> Allow students to assess their familiarity with the concepts presented in the theory classes and to prepare for the exams.</td>
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### ACTIVITY 4 - LABORATORY PRACTICE

**Description:**
Practical sessions in which assemblies are analyzed that allow to apply the acquired theoretical knowledge.

**Support materials:**
Calculator, class notes and recommended bibliography of the subject.

**Descriptions of the assignments due and their relation to the assessment:**
During class, a practical exercise of analyzing a structure similar to that studied in the laboratory will be performed. This exercise will be scored and will contribute to the final grade of the course (10%).

**Specific objectives:**
Allow students to apply their theoretical knowledge to a case study.

**Hours:** 9h 30m  
Practical classes: 3h  
Self study: 6h 30m

### ACTIVITY 5: MIDTERM EXAM

**Description:**
Written test in which problems related to the syllabus of module 2 of the subject will be solved.

**Support materials:**
Calculator

**Descriptions of the assignments due and their relation to the assessment:**
The mark of the exam will count 35% of the final grade of the subject.

**Specific objectives:**
Assess the level of use of module 2 of the subject.

**Hours:** 2h  
Theory classes: 2h

### ACTIVITY 6: FINAL EXAM AND MODULE 2 RECOVERY

**Description:**
Written test in which problems related to the syllabus of modules 3, 4 and 5 will be solved. It also includes an exam of optional recovery of the contents of module 2.

**Support materials:**
Calculator and, at the teacher’s discretion, class notes.

**Descriptions of the assignments due and their relation to the assessment:**
The mark of the exam will count 35% of the final grade of the subject.

**Specific objectives:**
Assess the level of proficiency of the subject.

**Hours:** 3h  
Theory classes: 3h
Qualification system

Mid-term exam (30%)
Final exam (30%)
Evaluable practical exercises, first part (20%)
Evaluable practical exercises and laboratory, second part (10%)

All those students who fail, want to improve their mark or cannot attend the partial exam, they will have the opportunity to be examined the same day of the final exam. If due to the circumstances it is not viable to do it the same day of the final exam, the teacher responsible for the subject will propose, via the platform Atenea, that the mentioned recovery exam will be carried out another day, in class schedule.

The new mark of the recovery exam will substitute the previous one, unless it is lower.

Regulations for carrying out activities

All the evaluable exams are individual

Bibliography

Basic:


Complementary:


Others resources:

Exercise collections solved.
Notes of the subject.