Course guides
330528 - CEV - Structural Calculations of the Vehicle

Unit in charge: Manresa School of Engineering
Teaching unit: 750 - EMIT - Department of Mining, Industrial and ICT Engineering.

Degree: BACHELOR’S DEGREE IN AUTOMOTIVE ENGINEERING (Syllabus 2017). (Compulsory subject).

Academic year: 2021  ECTS Credits: 6.0  Languages: Catalan, Spanish, English

LECTURER

Coordinating lecturer: Dr. J.J. de Felipe Blanch i Dr. Fausto Arias Araluce
Others: Dr. Fausto Arias Araluce

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CE26. Basic knowledge and application of environmental technologies and sustainability (Specific competence of the mention of Industrial Technologies).

Generical:
CG1. Ability to write and develop projects in the field of automotive engineering for the construction, renovation, repair, maintenance, recycling, manufacture, installation, assembly or operation of: structures, mechanical equipment, energy installations, electrical and electronic installations, plants and industrial plants and manufacturing and automation processes.
CG2. Capacity for management of the activities that are the subject of the engineering projects described in the previous section.
CG3. Knowledge of basic and technological subjects that will enable students to learn new methods and theories and that will endow them with the versatility needed to adapt to new situations.
CG4. Ability to solve problems with initiative, decision-making, creativity, critical reasoning and to communicate and transmit knowledge, skills and skills in the field of automotive engineering.
CG7. A capacity for analysing and assessing the social and environmental impact of technical solutions.

Transversal:
1. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 3. Communicating clearly and efficiently in oral and written presentations. Adapting to audiences and communication aims by using suitable strategies and means.
2. 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.
3. TEAMWORK - Level 3. Managing and making work groups effective. Resolving possible conflicts, valuing working with others, assessing the effectiveness of a team and presenting the final results.

Basic:
CB3. That students have the ability to gather and interpret relevant data (usually within their area of study) to make judgments that include a reflection on relevant social, scientific or ethical issues.
CB4. Students can transmit information, ideas, problems and solutions to a specialized and non-specialized audience.

TEACHING METHODOLOGY

MD1 Master class or conference (EXP)
MD2 Problem solving and case study (RP)
MD3 Practical lab work or workshop (TP)
MD5 Project, activity or reduced work (PR)
MD7 Project or broad work (PA)
LEARNING OBJECTIVES OF THE SUBJECT

The subject intends to provide basic knowledge about the construction of vehicles.

Among the different learning objectives are:
- Know the characteristics of the different types of constructive vehicles (racks / chassis / bodywork).
- Know and apply the techniques of calculation of construction of vehicles (virtual work, flexibility and rigidity method).
- Know and apply the structural modeling techniques of the vehicle.
- Know the different types of union used: threaded, welded, riveted, patches, etc.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Hours large group</td>
<td>30,0</td>
<td>20.00</td>
</tr>
<tr>
<td>Self study</td>
<td>90,0</td>
<td>60.00</td>
</tr>
<tr>
<td>Hours small group</td>
<td>30,0</td>
<td>20.00</td>
</tr>
</tbody>
</table>

Total learning time: 150 h

CONTENTS

1. Vehicle structure: racks, chassis and bodywork

- **Description:**
  Definition, function, typology, nomenclature and history of racks, chassis and bodywork.

- **Specific objectives:**
  Understanding and analysis of the different structural components of a vehicle and when and why they are used according to the type of the vehicle.

- **Related activities:**
  Specific work on content (Activity 1)

- **Full-or-part-time:** 10h
  Theory classes: 2h
  Laboratory classes: 2h
  Self study : 6h

2. Introduction to structural analysis

- **Description:**
  Structures, efforts, supports, knots, reactions and actions, linear theory, degree of hyperstaticity, degree of freedom

- **Specific objectives:**
  Comprehension, analysis, simple structures, determination of efforts and reactions and application of the linearity theory of the relationship between tensions and deformations. Understanding and analysis of isostatic, hyperstatic and hypostatic structures.

- **Related activities:**
  Specific work on content (Activity 2 & 6)

- **Full-or-part-time:** 30h
  Theory classes: 6h
  Laboratory classes: 6h
  Self study : 18h
3. Deformation energy and Navier-Bresse equations

Description:
Energy equations and Navier-Bresse equations. Application to structural calculation to solve hyperstatic and isostatic structures. Linking your results (e.g., turns and displacements) with the flexibility and stiffness methods.

Specific objectives:
Understand the theoretical bases of the calculation of structures through the energetic theorems of them eq. Navier-Bresse, apply them to the calculation of structures and verify their link with matrix analysis.

Related activities:
Specific work on content (Activity 3 & 6)

Full-or-part-time: 30h
Theory classes: 6h
Laboratory classes: 6h
Self study: 18h

4. Principle of Virtual Work. Special case of the energetic methods

Description:
Application of the principle of virtual works to structural calculation. Application of the unit load method to hyperstatic and isostatic structures. Linking your results with the flexibility and rigidity methods.

Specific objectives:
Understanding, analysis and application of the principles of virtual work in isostatic and hyperstatic structures.

Related activities:
Specific work on content (Activity 4 & 6)

Full-or-part-time: 30h
Theory classes: 6h
Laboratory classes: 6h
Self study: 18h

5. Introduction to matrix analysis. Methods of flexibility and rigidity

Description:
Application of the method of flexibility (hyperstatic) and rigidity for the calculation analysis of hyperstatic and isostatic structures.

Specific objectives:
Understanding, analysis and application of the methods of flexibility and rigidity for the analysis and calculation of hyperstatic and isostatic structures.

Related activities:
Specific work on content (Activity 5 & 6)

Full-or-part-time: 40h
Theory classes: 8h
Laboratory classes: 8h
Self study: 24h
6. Unions

**Description:**
Mechanical behavior and type of: Welding, rivets, threaded joints, glued joints, etc.

**Specific objectives:**
Understanding, analysis of the mechanical behavior of welding, rivets, threaded joints, glued joints.

**Related activities:**
Specific work on content (Activity 6)

**Full-or-part-time:** 10h
Theory classes: 2h
Laboratory classes: 2h
Self study: 6h

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**ACTIVITIES**

1. Typologies of racks, chassis and bodywork

**Description:**
Carry out a work on the automotive sector of those proposed by the teacher. Your public exposure must be made. (Evaluation of the transversal competence "Teamwork level 3")

**Specific objectives:**
Development of techniques and reasoning strategies for the analysis
Written and oral communication
Teamwork
Third language
Solvent use of information resources
Social Commitment and Sustainability
Innovation

**Material:**
In the digital campus "ATENEA"

**Delivery:**
5 % of the evaluation

**Full-or-part-time:** 6h
Theory classes: 1h
Self study: 5h
### 2. Tensions and efforts in a structure

**Description:**
Carry out a series of problems on the subject: to determine the different tensions and efforts in a structure. Determine the degree of hyperestatism of a structure proposed by the teacher. Your written delivery must be made.

**Specific objectives:**
- Development of techniques and reasoning strategies for the analysis
- Written and oral communication
- Teamwork
- Third language
- Solvent use of information resources
- Social Commitment and Sustainability
- Innovation

**Material:**
In the digital campus "ATENEA"

**Delivery:**
10 % of the evaluation

**Full-or-part-time:** 9h 36m
- Laboratory classes: 4h
- Self study: 5h 36m

### 3. Equations of Navier Bresse

**Description:**
Make a model and find and turns and displacements analytically / numerically using the eq. Navier-Bresse. Your written delivery must be made. The activity can be completed with the performance of laboratory practices with the corresponding reports and / or control questions either by means of specific examinations or questionnaires.

**Specific objectives:**
- Development of techniques and reasoning strategies for the analysis
- Written and oral communication
- Teamwork
- Third language
- Solvent use of information resources
- Social Commitment and Sustainability
- Innovation

**Material:**
In the digital campus "ATENEA"

**Delivery:**
10 % of the evaluation

**Full-or-part-time:** 7h 36m
- Laboratory classes: 2h
- Self study: 5h 36m
3. Principle of virtual work

Description:
Make a model of a car and found a piece of stress and strain for analytical / numerical fen used PVT. Your public exposure must be made.

Specific objectives:
Development of techniques and reasoning strategies for the analysis
Written and oral communication
Teamwork
Third language
Solvent use of information resources
Social Commitment and Sustainability
Innovation

Material:
In the digital campus "ATENEA"

Delivery:
20 % of the evaluation

Full-or-part-time: 7h 36m
Laboratory classes: 2h
Self study: 5h 36m

4. Flexibility method

Description:
Make a model of a car and found a piece of stress and strain for analytical / numerical fen used MF. Your public exposure must be made.

Specific objectives:
Development of techniques and reasoning strategies for the analysis
Written and oral communication
Teamwork
Third language
Solvent use of information resources
Social Commitment and Sustainability
Innovation

Material:
In the digital campus "Atenea"

Delivery:
25 % of the evaluation

Full-or-part-time: 11h 24m
Laboratory classes: 3h
Self study: 8h 24m
6. Test

Description:
Write a written test on the whole subject.

Specific objectives:
Development of techniques and reasoning strategies for the analysis
Written and oral communication
Third language
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43/5000
Solvent use of information resources

Material:
In the digital campus "ATENEA"

Delivery:
30 % of the evaluation

Full-or-part-time: 16h
Theory classes: 1h
Self study: 15h

GRADING SYSTEM

Activity 1: 5% grade
Activity 2: 10% grade
Activity 3: 10% grade
Activity 4: 20% grade
Activity 5: 25 % grade
Activity 6: 30 % grade

BIBLIOGRAPHY

Basic:

Complementary:
RESOURCES

Other resources:
In the digital campus "ATENEA"