Course guide
330534 - DV - Vehicle Dynamics

Unit in charge: Manresa School of Engineering
Teaching unit: 712 - EM - Department of Mechanical Engineering.
Degree: BACHELOR'S DEGREE IN AUTOMOTIVE ENGINEERING (Syllabus 2017). (Compulsory subject).
Academic year: 2022 ECTS Credits: 6.0 Languages: Catalan

LECTURER
Coordinating lecturer: Català Calderón, Pau
Others: Peña Pitarch, Esteban

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

General:
CG11. Ability to write and develop projects for vehicles and/or their components.

Transversal:
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.
04 COE. EFFICIENT ORAL AND WRITTEN COMMUNICATION. Communicating verbally and in writing about learning outcomes, thought-building and decision-making. Taking part in debates about issues related to the own field of specialization.
05 TEQ. TEAMWORK. Being able to work as a team player, either as a member or as a leader. Contributing to projects pragmatically and responsibly, by reaching commitments in accordance to the resources that are available.

TEACHING METHODOLOGY
- Master class or conference.
- Problem solving and case study.
- Project, activity or work of reduced scope.
- Project or work of wide scope.
- Evaluation activities.

LEARNING OBJECTIVES OF THE SUBJECT

At the end of the course, students must be able to:
- To apply correctly the fundamental concepts of the statics, kinematics and dynamics of the rigid solid and to be able to apply them to practical cases of automotive engineering.
- Know the different auxiliary mechanisms of a vehicle, as well as be able to carry out its design.
- Apply the basic concepts of the kinematics and dynamics of a vehicle and be able to apply them to practical cases in automotive engineering.
**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>
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**Total learning time:** 150 h

**CONTENTS**

1. **Introduction to vehicle dynamics**
   
   **Description:**
   
   **Related activities:**
   PROB, SIM, PAR, EP1, EFINAL
   
   **Full-or-part-time:** 20h
   Theory classes: 4h
   Practical classes: 4h
   Self study: 12h

2. **Wheel dynamics. Tires**
   
   **Description:**
   
   **Related activities:**
   PROB, SIM, PAR, EP1, EFINAL
   
   **Full-or-part-time:** 10h
   Theory classes: 2h
   Practical classes: 2h
   Self study: 6h

3. **Longitudinal dynamics**
   
   **Description:**
   Maximum acceleration. Engine power. Maximum acceleration. Tractor capacity driving wheels.
   
   **Related activities:**
   PROB, SIM, PAR, EP1, EFINAL
   
   **Full-or-part-time:** 40h
   Theory classes: 8h
   Practical classes: 8h
   Self study: 24h
4. Braking performance

Description:

Related activities:
PROB, SIM, PAR, EP2, EFINAL

Full-or-part-time: 20h
Theory classes: 4h
Practical classes: 4h
Self study : 12h

5. The steering system

Description:

Related activities:
PROB, SIM, PAR, EP2, EFINAL

Full-or-part-time: 32h
Theory classes: 6h
Practical classes: 6h
Self study : 20h

6. Suspension system

Description:
Suspension system. Roll Centers and roll axis. Study of the rolling motion of a vehicle.

Related activities:
PROB, SIM, PAR, EP2, EFINAL

Full-or-part-time: 20h
Theory classes: 4h
Practical classes: 4h
Self study : 12h

7. Vibration analysis

Description:

Full-or-part-time: 8h
Theory classes: 2h
Practical classes: 2h
Self study : 4h
### ACTIVITIES

<table>
<thead>
<tr>
<th>Partial Exam 1</th>
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<tr>
<td><strong>Description:</strong> Assessment of acquired knowledge</td>
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<tr>
<td><strong>Delivery:</strong> Delivered exam</td>
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<tr>
<td><strong>Full-or-part-time:</strong> 44h</td>
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<tr>
<td>Theory classes: 2h</td>
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<td>Self study: 42h</td>
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<th>Partial Exam 2</th>
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<tr>
<td><strong>Description:</strong> Assessment of acquired knowledge</td>
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<tr>
<td><strong>Delivery:</strong> Delivered exam</td>
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<tr>
<td><strong>Full-or-part-time:</strong> 50h</td>
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<tr>
<td>Theory classes: 2h</td>
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<td>Self study: 48h</td>
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<th>Final Exam</th>
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<td><strong>Description:</strong> Assessment of acquired knowledge</td>
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<td><strong>Delivery:</strong> Delivered exam</td>
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<tr>
<td><strong>Full-or-part-time:</strong> 93h</td>
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<td>Theory classes: 3h</td>
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<td>Self study: 90h</td>
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<th>Problems delivery</th>
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<tr>
<td><strong>Description:</strong> Delivery of technical reports explaining the resolution of problems related to real cars.</td>
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<tr>
<td><strong>Delivery:</strong> Technical report</td>
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<td><strong>Full-or-part-time:</strong> 16h</td>
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<td>Guided activities: 16h</td>
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Simulation Report

Description:
Delivery of a technical report explaining the results obtained by using an MBD simulation software of a complete vehicle and some of its mechanical subsystems. These simulated results must be contrasted with analytical values obtained through the theoretical content presented in the subject.

Delivery:
Technical report and simulation files.

**Full-or-part-time:** 26h
Practical classes: 10h
Self study: 16h

Class participation

Description:
attendance and participation in class and laboratories. Online tests can be proposed to be solved by the students of the content explained in class.

Delivery:
Class participation and tests

**Full-or-part-time:** 1h
Theory classes: 1h

GRADING SYSTEM

- PROB: Delivery of proposed problems (10%).
- SIM: Simulation report (15%).
- PAR: Class attendance and participation (5%).
- EP1: Partial exam 1 (35%).
- EP2: Partial exam 2 (35%).
- FINAL: Recovery exam (70%).

The final grade (NFINAL), rounded to the tenth, will be the next weighted average.

\[
NFINAL = \max (70\% \cdot EFINAL, 35\% \cdot EP1 + 35\% \cdot EP2) + 10\% \cdot PROB + 15\% \cdot SIM + 5\% \cdot PAR.
\]

Students who fail to pass the subject in part (EP1, EP2) or those who want to improve their qualification, they will have a second chance with a new final test (EFINAL).

EXAMINATION RULES.

- Late deliveries will not be accepted (SIM, PROB). Deliveries must be made via the ATENEA campus.
- In the delivery any total or partial copy of solutions will suppose the suspension to the activity. The student must ensure the privacy and security of their data.
- The structure and rules of the exams of the subject (EP1, EP2, EFINAL) are the following:
  - **Duration:** 2 h - 3 h
  - **Part of theory:** (3 points). Test questions and open-ended questions. No form or notes.
  - **Part of problems:** (7 points). Between one and three problems. With form and / or notes.
BIBLIOGRAPHY

Basic:

RESOURCES

Other resources:
Class presentations and MBD simulation software with specific toolkits for vehicle dynamics.