330501 - ALG - Algebra

Coordinating unit: 330 - EPSEM - Manresa School of Engineering
Teaching unit: 749 - MAT - Department of Mathematics
Academic year: 2019
Degree: BACHELOR'S DEGREE IN AUTOMOTIVE ENGINEERING (Syllabus 2017). (Teaching unit Compulsory)
ECTS credits: 6
Teaching languages: English

Teaching staff
Coordinator: Alsina Aubach, Montserrat

Degree competences to which the subject contributes

Basic:
CB1. Students will be able to demonstrate their knowledge of a field of study that builds on secondary education and is usually found at a level that, while supported by advanced textbooks, also includes aspects that involve knowledge of the latest developments in the field of study.
CB2. Students will be able to apply their knowledge to their work or vocation in a professional manner and demonstrate that they possess the competencies that are typically demonstrated by elaborating and defending arguments and solving problems in the field of study.

Specific:
CE1. Ability to solve mathematical problems that may arise in engineering. Ability to apply knowledge about: linear algebra; geometry; differential geometry; differential and integral calculus; differential equations and partial derivatives; numerical methods; numerical algorithms; statistics and optimization.

General:
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.
CG10. The ability to work in a multilingual and multidisciplinary environment.

Transversal:
1. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 1. Planning oral communication, answering questions properly and writing straightforward texts that are spelt correctly and are grammatically coherent.
2. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.
3. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.
4. EFFECTIVE USE OF INFORMATION RESOURCES - Level 1. Identifying information needs. Using collections, premises and services that are available for designing and executing simple searches that are suited to the topic.

Teaching methodology

MD1 Master class or lecture (EXP)
MD2 Problem solving and case study (RP)
MD5 Small-scale project, activity or assignment (PR)
MD6 Large-scale project, activity or assignment (PA)
MD7 Assessment activities (EV)

Learning objectives of the subject
330501 - ALG - Algebra

Students should learn and understand the fundamental concepts of linear algebra and geometry; develop their analytical abilities and logical thinking, increasing their capacity for abstraction and generalisation; learn to apply linear algebra techniques to set and solve problems and to think of methods and algorithms for solving them; and learn to obtain and interpret results by means of computer programs.

<table>
<thead>
<tr>
<th>Study load</th>
<th>Hours large group:</th>
<th>30h</th>
<th>20.00%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hours medium group:</td>
<td>0h</td>
<td>0.00%</td>
</tr>
<tr>
<td></td>
<td>Hours small group:</td>
<td>30h</td>
<td>20.00%</td>
</tr>
<tr>
<td></td>
<td>Guided activities:</td>
<td>0h</td>
<td>0.00%</td>
</tr>
<tr>
<td></td>
<td>Self study:</td>
<td>90h</td>
<td>60.00%</td>
</tr>
</tbody>
</table>
# 1. Algebraic structures

**Learning time:** 40h  
Theory classes: 8h  
Laboratory classes: 8h  
Self study: 24h

**Description:**  

**Related activities:**  
TA, A12, E12, E1234

**Specific objectives:**  
To learn different algebraic structures and their properties. To learn to solve systems of linear equations by using matrices.

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# 2. Vector spaces and applications

**Learning time:** 35h  
Theory classes: 7h  
Laboratory classes: 7h  
Self study: 21h

**Description:**  

**Related activities:**  
TA, A12, E12, E1234

**Specific objectives:**  
To learn the fundamental concepts of linear algebra in the framework of vector spaces, linear transformations and their matrix representations.

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# 3. Eigenvalues and eigenvectors

**Learning time:** 40h  
Theory classes: 8h  
Laboratory classes: 8h  
Self study: 24h

**Description:**  

**Related activities:**  
TA, A34, E34, E1234

**Specific objectives:**  
To learn to compute and interpret eigenvalues and eigenvectors to classify matrices and solve related problems.
4. Linear variety, quadratic forms and geometric transformations

<table>
<thead>
<tr>
<th>Description:</th>
<th>Learning time: 35h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Affine geometry, equations and reference systems. Inner products. Quadratic forms and symmetric matrices. Motions and isometries.</td>
<td>Theory classes: 7h</td>
</tr>
<tr>
<td></td>
<td>Laboratory classes: 7h</td>
</tr>
<tr>
<td></td>
<td>Self study: 21h</td>
</tr>
</tbody>
</table>

**Related activities:**
TA, A34, E34, E1234

**Specific objectives:**
To generalise and apply the above content to geometry in order to understand representations of objects and motions.
### Planning of activities

<table>
<thead>
<tr>
<th>Activity</th>
<th>Hours</th>
<th>Description</th>
<th>Support materials</th>
<th>Specific objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Algebra lab - TA</strong></td>
<td>40h</td>
<td>Introduction and practice of software for symbolic manipulation and numerical computations involving the content of the course, in order to solve related problems. Assessment of the level of learning achieved.</td>
<td>Suitable software available on the computers in the lab (Matlab or similar). Lab guidelines or assignments, and quizzes.</td>
<td>To learn to use software to solve problems related to the course topics.</td>
</tr>
<tr>
<td><strong>Assignment - A12</strong></td>
<td>8h</td>
<td>An activity to assess the achievements related to Topics 1 and 2.</td>
<td>Assignment guidelines, virtual campus material and suitable course notes.</td>
<td>To review the achievement of the aims of Topics 1 and 2, in order to check whether students need to review their learning process.</td>
</tr>
<tr>
<td><strong>Written exam - E12</strong></td>
<td>8h</td>
<td>Individual written exam to assess the learning goals of Topics 1 and 2.</td>
<td>Exam paper delivered by the professor.</td>
<td>To assess the achievement of the aims of Topics 1 and 2.</td>
</tr>
</tbody>
</table>

**Laboratory classes: 10h**

**Self study: 30h**

**Laboratory classes: 2h**

**Self study: 6h**

**Theory classes: 2h**

**Self study: 6h**

**Hours:** 40h

**Laboratory classes:** 10h

**Self study:** 30h

**Hours:** 8h

**Laboratory classes:** 2h

**Self study:** 6h

**Hours:** 8h

**Theory classes:** 2h

**Self study:** 6h
### Assignment - A34

**Description:**
Activity to assess the achievements related to Topics 3 and 4.

**Support materials:**
Assignment guidelines, virtual campus material and documentary material.

**Descriptions of the assignments due and their relation to the assessment:**
Assignments must be submitted to the professor.

**Specific objectives:**
To review the achievement of the aims of Topics 3 and 4, in order to check whether students need to review their learning process.

| Hours | Laboratory classes: 2h  
Self study: 6h |
|-------|-------------------------|

### Written exam - E34

**Description:**
Individual written exam to assess the learning goals of Topics 3 and 4.

**Support materials:**
Exam paper delivered by the professor.

**Descriptions of the assignments due and their relation to the assessment:**
Completed exams must be submitted to the professor.

**Specific objectives:**
To assess the achievement of the aims of Topics 3 and 4.

| Hours | Theory classes: 2h  
Self study: 6h |
|-------|-------------------------|

### Global written exam - E1234

**Description:**
Individual written exam to assess the learning goals of Topics 1, 2, 3 and 4.

**Support materials:**
Exam sheet delivered by the professor.

**Descriptions of the assignments due and their relation to the assessment:**
Written exams must be submitted to the professor.

**Specific objectives:**
To assess the achievement of the aims of course.

| Hours | Theory classes: 3h  
Self study: 9h |
|-------|-------------------------|
Qualification system

The COURSE MARK (NC) is computed from the activities carried out during the semester, as follows:

\[ NC = 0.10(TA) + 0.20(A12 + A34)/2 + 0.70(E12 + E34)/2 \]

The FINAL MARK (NF) allows the COURSE MARK (NC) to be improved and is computed from the activity Algebra Lab (TA) and the final written exam (E1234) (compulsory only if the course mark is less than 5) as follows:

\[ NF = \text{maximum} (NC, 0.10(TA) + 0.90(E1234)) \]

Regulations for carrying out activities

Regular attendance is expected and critical for success on the course but there will not be a register.

Activities are compulsory for all the students, except activity E1234, which will be optional if the Course Mark NC is greater than or equal to 5.

Activities not submitted will count as 0 in the calculation of marks.

Bibliography

Basic:

Complementary:

Others resources: