Course guide
310601 - 310601 - Algebra

Unit in charge: Barcelona School of Building Construction
Teaching unit: 749 - MAT - Department of Mathematics.
Degree: BACHELOR'S DEGREE IN GEOINFORMATION AND GEOMATICS ENGINEERING (Syllabus 2016). (Compulsory subject).
Academic year: 2022  ECTS Credits: 6.0  Languages: Catalan, Spanish, English

LECTURER

Coordinating lecturer: Chara Pantazi
Others: Antoni Guillamon Grabolosa

PRIOR SKILLS

High school math curriculum.

REQUIREMENTS

As a subject of the semester 1A, there are no requirements.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. Capacity for the resolution of mathematic problems that can be set out in engineering. Aptitude to apply the knowledge about: linear algebra, geometry, differential geometry, differential and integral calculus, differential equations and in partial derivates, numeric methods, numeric algorithm, statistics and optimization.
2. (ENG) Determinar, mesurar, avaluar i representar el terreny, objectes tridimensionals, punts i trajectòries.
3. (ENG) Planificació, projecte, direcció, execució i gestió de processos de mesura, sistemes d'informació, explotació d'imatges, posicionament i navegació; modelització, representació i visualització de la informació territorial en, sota i sobre la superfície terrestre.

Transversal:
5. 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.

TEACHING METHODOLOGY

It will be used the following methodology:
Expositive method for the content strictly theoretical.
Expositive-participatory for the majority of the units.
Resolution of exercises and problems
Practices using Matlab
LEARNING OBJECTIVES OF THE SUBJECT

At the end of the subject, the student must be capable of:
Describe the basic elements of Linear Algebra related to the vectorial spaces and linear applications and explain its principal characteristics.
Classify and solve systems of determinated, indeterminated and over-determinated linear equations.
Describe and use geometric transformations and changes with the referent systems.
Define and classify quadratic, form and quadric forms.
Define, enumerate the principal properties and resolve flat and esferic triangles.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
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<tbody>
<tr>
<td>Self study</td>
<td>90,0</td>
<td>60.00</td>
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<tr>
<td>Hours medium group</td>
<td>36,0</td>
<td>24.00</td>
</tr>
<tr>
<td>Hours large group</td>
<td>24,0</td>
<td>16.00</td>
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</tbody>
</table>

Total learning time: 150 h

CONTENTS

C1 Vector Spaces

Description:
In this content the following topics will be developed:
Operations between scales and vectors.
Lineal independency. Bases and dimension.
Matrix and determinant
Euclidean space. Scalar product

Specific objectives:
At the end of the content, the student must be capable of:
Enumerate the operations between scalars and vectors and their properties.
Recognise if a system of vectors is independent or dependent.
Know the most important properties of matrices and determinants.

Related activities:
Theory classes
Problem classes
a task, T1
Laboratory with Matlab. Activity L1
Practice exam of questions. Activity Q1
Theoretical exam test type. Activity Test-1

Full-or-part-time: 25h
Theory classes: 5h
Practical classes: 2h 30m
Laboratory classes: 2h 30m
Self study : 15h
C2 Linear Transformations

Description:
In this content the following topics are developed:
- Recognize if a function is a linear transformation or not
- Linear transformation of a matrix
- Geometric interpretation of the linear transformations of 2 and 3 variables
- Change of base
- Invariant directions and diagonal form of a transformation.

Specific objectives:
- At the end of the content, the student must be capable of:
  - Recognize if a function is a linear transformation or not, and, in the case is not, express the in matrix
  - Interpret geometrically the linear transformations of 2 and 3 variables
  - Express a plane and a straight line in the 3D space and resolve incidence problems
  - Define and calculate the invariant directions and the diagonal form of a transformation.

Related activities:
- Theory classes
- Problem classes
- A Task, T1
- Laboratory with Matlab. Activity L2
- Practice exam of questions. Activity Q1
- Theoretical exam test type. Activity Test-1

Full-or-part-time: 30h
- Theory classes: 6h
- Practical classes: 3h
- Laboratory classes: 3h
- Self study: 18h

C3 Numerical Solution of Linear Systems

Description:
In this content the following topics are developed:
- Decomposition LU
- Decomposition QR
- Resolution of linear determined, undetermined and overdetermined equation systems

Specific objectives:
- At the end of the content, the student must be capable of:
  - Do the decomposition LU, in a square matrix and resolve the certain systems by this decomposition
  - Resolve overcertain systems according to the criteria of minimum squares and the system of normal equations
  - Do the decomposition QR of a matrix and resolve overdetermined according to this decomposition.

Related activities:
- Theory classes
- Problem classes
- A Task, T1
- Laboratory practices of calculus with Matlab. Activity L2
- Practice exam of questions. Activity Q2
- Theoretical exam test type. Activity Test-2

Full-or-part-time: 25h
- Theory classes: 5h
- Practical classes: 2h 30m
- Laboratory classes: 2h 30m
- Self study: 15h
C4 Change of Reference Systems

Description:
At the end of this content the following topics will be developed:
Similarity transformations
Related transformations
Bilineal transformations
Projective transformations. Colinearity equation
Coplanarity equation

Specific objectives:
At the end of the content, the student must be capable of:
Define, recognise and express a similarity transformation and estimate their parameters
Define, recognise and express related transformations and estimate their parameters
Define, recognise and express a bilineal transformation and estimate their parameters
Define, recognise and express projective transformations and estimate their parameters
Define, recognise and express a colinearity equation
Define, recognise and express a coplanarity equation

Related activities:
Theory classes
Problem classes
A Task, T2
Laboratory with Matlab. Activity L3
Practice exam of questions. Activity Q2
Theoretical exam test type. Activity Test-2

Full-or-part-time: 25h
Theory classes: 5h
Practical classes: 2h 30m
Laboratory classes: 2h 30m
Self study: 15h
C5 Quadratic Forms

Description:
In this content the following topics will be developed:
- Tensors
- Quadratic forms
- Conics
- Quadric

Specific objectives:
At the end of the content, the student must be capable of:
- Define tensor and quadratic form
- Express the matrix form and the change of base
- Calculate the the reduced form
- Classify a quadratic form
- Define conic and quadric, express and analize them in their reduced form
- Do transformations of coordinates in the equations of a conic and a quadric

Related activities:
- Theory classes
- Problem classes
- A Tasks, T3
- Laboratory with Matlab. Activity L4
- Practice exam of questions. Activity Q2
- Theoretical exam test type. Activity Test-2

Full-or-part-time: 20h
- Theory classes: 4h
- Practical classes: 2h
- Laboratory classes: 2h
- Self study: 12h

C6 Spherical Trigonometry

Description:
In this content the following topics will be developed:
- Spherical triangles
- Resolution of spherical triangles

Specific objectives:
At the end of the content, the student must be capable of:
- Define spherical triangle and enumerate the main properties
- Resolve spherical triangles

Related activities:
- Theory classes
- Problem classes
- One Task, T2
- Laboratory practices of calculus with Matlab. Activity L4
- Practice exam of questions. Activity Q2
- Theoretical exam test type. Activity Test-2

Full-or-part-time: 20h
- Theory classes: 4h
- Practical classes: 2h
- Laboratory classes: 2h
- Self study: 12h
ACTIVITIES

T1

Description:
Individual or group work, delivery of certain exercises or short test of 60 minutes

Specific objectives:
At the end of this activity, the student must be capable of verifying the grade of achievement of the practical concepts and mechanisms related to the contents 1,2 and 3

Material:
certain websites and class notes

Delivery:
Atenea

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

L1

Description:
Practice with Matlab. The language of this activity will be English

Specific objectives:
At the end of the practice the student must be capable of doing operations with vectors and matrixs, resolve lineal systems, and work with the scalar and vectorial product with Matlab and resolution of linear systems

Material:
Matlab

Delivery:
The practice with Matlab support

Full-or-part-time: 2h
Laboratory classes: 2h

L2

Description:
Practice with Matlab. The language of this activity will be English

Specific objectives:
At the end of this practice the student must be capable of defining a lineal transformation, do base changes and diagonalize matrix with Matlab

Material:
Matlab

Delivery:
Test with questions about the practice

Full-or-part-time: 2h
Laboratory classes: 2h
### Test-1

**Description:**
Test

**Specific objectives:**
At the end of this activity, the student must be capable of verifying the grade of achievement of the theoretical concepts related to the contents 1, 2 and 3

**Material:**
Questions of test

**Delivery:**
Test answered

**Full-or-part-time:** 0h 30m
Theory classes: 0h 30m

### (ENG) Q1

**Description:**
Question test

**Specific objectives:**
At the end of this activity, the student must be capable of verifying the grade of achievement of the practical concepts and mechanisms related to the contents 1, 2 and 3

**Material:**
Wording

**Delivery:**
Questions answered

**Full-or-part-time:** 1h 30m
Theory classes: 1h 30m

### L3

**Description:**
Practice with Matlab. The language of this activity will be English

**Specific objectives:**
At the end of this practice, the student must be capable of working with transformations of coordinates applied to conics and quadrics using the Matlab program

**Material:**
Matlab

**Delivery:**
The practice with Matlab support

**Full-or-part-time:** 2h
Laboratory classes: 2h
**L4**

**Description:**
Practice with Matlab. The language of this activity will be English

**Specific objectives:**
At the end of this practice, the student must be capable of working with the resolution of a triangular plane or esferic using Matlab

**Material:**
Matlab

**Delivery:**
The practice with Matlab support

**Full-or-part-time:** 2h
Laboratory classes: 2h

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**ENG Q2**

**Description:**
Question test

**Specific objectives:**
At the end of this activity, the student must be capable of verifying the grade of achievement of the practical concepts and mechanisms related to the contents 4 to 6

**Material:**
Wording

**Delivery:**
Questions answered

**Full-or-part-time:** 1h 30m
Theory classes: 1h 30m

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**T2**

**Description:**
This task is a delivery of certain exercises.

**Specific objectives:**
At the end of this activity, the student must be capable of verifying the grade of achievement of the practical concepts and mechanisms related to the contents 4-6

**Material:**
Wording

**Delivery:**
Exercises answered

**Full-or-part-time:** 1h
Theory classes: 1h
GENERIC COMPETENCE 3RD LANGUAGE

Description:
In order to develop generic competence in a 3rd language, the laboratory practices will be carried out in English

Full-or-part-time: 16h
Theory classes: 8h
Laboratory classes: 8h

Test-2

Description:
Test

Specific objectives:
At the end of this activity, the student must be capable of verifying the grade of achievement of the theoretical concepts related to the contents 4 to 6

Material:
Test questions

Delivery:
Test answered

Full-or-part-time: 0h 30m
Theory classes: 0h 30m

GRADING SYSTEM

Contents 1,2 and 3
An exam with questions and a theory test: 30% of the final mark
Two practices using matlab: 5% of the final mark each one
A tasks: 5% of the final mark

Contents from 3 to 6
An exam with questions and a theory test: 30% of the final mark
Two practices using matlab: 5% of the final mark each one
A tasks: 5% of the final mark

In the re-evaluation will be examined all the materia.

EXAMINATION RULES.

The exams of questions and theory tests corresponding to the contents 1 and 2 will be made during the period of exams in the middle of the four-month period. The exams of questions and theory tests corresponding to the contents from 3 to 6 will be made during the period of exams at the end of the four-month period. The practices will be made, approximately, during the 4rd, 6th, 10th and 12th week of class. The tasks will be made during the 5th and 11th week of the class.
BIBLIOGRAPHY

Basic:

Complementary:

RESOURCES

Other resources:
The subject has a course at the virtual campus ATENEA where may be found:
A link to the teacher?s guide
A PDF file where will be keep track of the activities developed
A repository of practices to solve
A repository of solved exercises
A solved repository of exams
A repository of tasks to perform
The grades of the different evaluable tests.