Course guide
310601 - 310601 - Algebra

Last modified: 10/02/2025

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: 2024 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish, English

LECTURER

Coordinating lecturer: Chara Pantazi

Others: Amadeu Delshams I Valdes

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, stadistics 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

The following methodologies will be used:
Expositive method for the content strictly theoretical.
Espositive-participatory class 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 able to:
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 spherical triangles.

STUDY LOAD

Type	Hours	Percentage
Hours large group	24,0	16.00
Self study	90,0	60.00
Hours medium group	36,0	24.00

Total learning time: 150 h

CONTENTS

C1 Vector Spaces

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

Specific objectives:
At the end of this content, students should be able to:
List the operations between scalars and vectors and their properties.
Recognize if a vector system is independent or dependent.
Recognize whether or not a subset is a subspace and, if it is, find the dimension and a base.
Know the most important properties of matrices and determinants.
Perform operations between matrices and calculate determinants.
Define Euclidean space and scalar product and list the main properties.
Solve metric problems between planes and lines in 3D space.

Related activities:
Theory classes
Problem classes
A task, T1
EngiMath, EM or similar
Laboratories with Matlab. Activity L1
Practical exam of questions. Activity Q1
Multiple choice theoretical exam. 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 lineal transformation or not
Lineal transformation of a matrix
Geometric interpretation of the lineal 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 lineal transformation or not and, in the case is not, exprese the in matrix
Interpretate geometrically the lineal transformations of 2 and 3 variables
Express a plane and a straight line in the 3D space and resolve incidence problems
Solve linear equation systems: determined, undetermined and overdetermined and interpret them graphically.
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 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, T2
Laboratory with Matlab. Activity L3
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

C4 Numerical Solution of Linear Systems

Description:
In this content the following topics are developed:
Descomposition LU
Descomposition QR
Resolution of lineal 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 decompostion.

Related activities:
Theory classes
Problem classes
A Task, T2
Laboratory practices of calculus 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 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 L4
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

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 diagonalizate 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

EM

Description:
Realization of activities with EngiMath or similar

Full-or-part-time: 3h
Self study: 3h

(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

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

T2

Description:
In group or individual task, delivery of certain exercises or a short test in 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 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 and 2
An exam with questions and a theory test: 30% of the final mark
Two practices using matlab: 2.5% of the final mark each
Realization of EngiMath or similar: 5% of the final mark
A task: 5% of the final mark

Contents from 3 to 6
An exam with questions and a theory test: 45% of the final mark
Two practices using matlab: 2.5% of the final mark each one
A task: 5% of the final mark

In the re-evaluation all material will be examined.

EXAMINATION RULES.

The exams of questions and theory tests corresponding to the contents 1 and 2 will take place during the exam period in the middle of the semester. The exams of questions and theory tests corresponding to the contents from 3 to 6 will take place during the exam period at the end of the semester. The practices will take place, aproximately, during the 4th, 6th, 10th and 12th week of class. The tasks will take place during the 5th and 11th week of class.

BIBLIOGRAPHY

Basic:

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Complementary:

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- Larry E. Knop. Linear algebra : a first course with applications [on line]. LondonNew York: Boca Raton, FL ; London ; New York : CRC Press/Taylor & Francis, cop. 2009, 2009 [Consultation: 01/07/2020]. Available on: https://cataleg.upc.edu/search*cat/?searchtype=t&searcharg=Linear+Algebra%3A+A+First+Course+with+Applications&SORT=D&sortdropdown=-&searchtype_aux=t&searchscope=1. ISBN 9781584887829 (cart.) 1584887826.

RESOURCES

Computer material:

- MATLAB. Resource

Other resources:
The subject has a course at the virtual campus ATENEA (http://atenea.upc.edu) />where may be found:
An introductory course
A link to the teachers guide
A link to EngiMath
A PDF file where the activities developed will be kept track
A repository of practices to solve
A repository of solved exercises
A repository of solved exams
A repository of tasks to perform
The grades of the different evaluable tests.