Course guide
200005 - GAE - Affine and Euclidean Geometry

Last modified: 21/06/2023

Unit in charge: School of Mathematics and Statistics
Teaching unit: 749 - MAT - Department of Mathematics.

Degree: BACHELOR'S DEGREE IN MATHEMATICS (Syllabus 2009). (Compulsory subject).

Academic year: 2023 **ECTS Credits:** 7.5 **Languages:** Catalan

LECTURER

Coordinating lecturer: JESUS FERNANDEZ SANCHEZ

Others: Segon quadrimestre:
JOSEP ALVAREZ MONTANER - M-B
JESUS FERNANDEZ SANCHEZ - M-A, M-B
FRANCESC D'ASSIS PLANAS VILANOVA - M-A

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. CE-2. Solve problems in Mathematics, through basic calculation skills, taking in account tools availability and the constraints of time and resources.
2. CE-3. Have the knowledge of specific programming languages and software.
3. CE-4. Have the ability to use computational tools as an aid to mathematical processes.

Generical:
4. CB-1. Demonstrate knowledge and understanding in Mathematics that is founded upon and extends that typically associated with Bachelor's level, and that provides a basis for originality in developing and applying ideas, often within a research context.
5. CB-2. Know how to apply their mathematical knowledge and understanding, and problem solving abilities in new or unfamiliar environments within broader or multidisciplinary contexts related to Mathematics.
6. CB-3. Have the ability to integrate knowledge and handle complexity, and formulate judgements with incomplete or limited information, but that include reflecting on social and ethical responsibilities linked to the application of their knowledge and judgements.
7. CG-1. Show knowledge and proficiency in the use of mathematical language.
8. CG-2. Construct rigorous proofs of some classical theorems in a variety of fields of Mathematics.
9. CG-3. Have the ability to define new mathematical objects in terms of others already know and ability to use these objects in different contexts.
10. CG-4. Translate into mathematical terms problems stated in non-mathematical language, and take advantage of this translation to solve them.
12. CG-6 Detect deficiencies in their own knowledge and pass them through critical reflection and choice of the best action to extend this knowledge.

Transversal:
11. SELF-DIRECTED LEARNING. Detecting gaps in one's knowledge and overcoming them through critical self-appraisal. Choosing the best path for broadening one's knowledge.

TEACHING METHODOLOGY

(Section not available)

LEARNING OBJECTIVES OF THE SUBJECT

The main goal of the course is to learn the basic concepts of affine and Euclidean geometry and to be able to manipulate them with skill. More specifically, at the content level, it is intended that students:
-Know the classical approach to geometry and at the same time understand and assimilate its modern treatment based on the concepts and methods of Linear Algebra.
-Understand the notion of (real) affine space as a mathematical model of physical space and know in some detail the internals of the model, in particular the notions of linear variety, affine application and the basic examples of affinities.
-Know the notion of reference in an affine space as a tool to describe previous objects in terms of coordinates.
-Understand the notion of metric as a method of formalizing the intuitive notion of distance
-Know all the basic concepts associated with the Euclidean affine space structure (distances,
perpendicularity, orthogonal projections,...), as well as the more specific concepts of dimensions 2 and 3 (angles, vector product), and know how to manipulate them (in particular, to calculate areas and volumes).
-Know what displacements are like in a straight line, in a plane and in space.
-Know the geometric figures that correspond to second degree equations in dimension 2 and their main characteristics, as well as some notions referring to the case of dimension 3.
-Know some practical applications of the above concepts, such as applications in physics and technology.)

STUDY LOAD

Type	Hours	Percentage
Hours large group	45,0	24.00
Guided activities	7,5	4.00
Self study	105,0	56.00
Hours small group	30,0	16.00

Total learning time: 187.5 h

CONTENTS

1. AFFINE SPACE

Description:
Affine space, linear varieties, relative positions. Cartesian and baricentric coordinate systems. Simple ratio. Theorems of Thales, Ceva, Menelao and Desargues.

Full-or-part-time: 25h
Theory classes: 9h
Practical classes: 6h
Self study : 10h

2. AFFINE MAPS

Description:
Affine maps. Basic properties. The central theorem of affine geometry. Invariant varieties. Families of affine maps: translations, dilatations, projections and symmetries. Classfication of affine maps in dimensions 1 and 2.

Full-or-part-time: 29h 20m
Theory classes: 9h
Practical classes: 7h
Self study : 13h 20m

3. EUCLIDEAN GEOMETRY

Description:
Euclidean space, metrics. Distances, area, angles and volumes. Orthogonality and orthogonal projection. Oriented angles. Cross product. Some classic theorems of plane geometry.

Full-or-part-time: 22h 50m
Theory classes: 6h
Practical classes: 3h 30m
Self study : 13h 20m

4. MOVMENTS

Description:
Isometries and movements. Study and clasification of movements in dimension 1, 2 and 3.

Full-or-part-time: 16h
Theory classes: 10h
Practical classes: 5h
Self study : 1h

5. CONICS AND QUADRICS

Description:
Adapted coordinate systems. Relevant points and lines. Affine and metric classifications. Detailed study of non-degenerated conics and quadrics. Polarity. Study of affine and metric properties.

Teaching of this topic is subject to time availability.

Full-or-part-time: 27h 20m
Theory classes: 8h
Practical classes: 6h
Self study : 13h 20m

GRADING SYSTEM

A continuous assessment (CA) is proposed based on solving exercises ("entregables").
There will be a Midterm exam (ME).
The final exam (FE) will consist of one part containing problems and a final theoretical part.
The final mark (FM) will result from: FM=màx {0.1 AC + 0.2 EP + 0.7 EF; 0.2 EP + 0,8 EF; 0.1 AC+0.9 EF; EF}

An extra exam will take place on July for students that failed during the regular semester. In this case, the final mark of the course will be given by the formula
NF=max {0.1 AC + 0.2 EP + 0.7 ER; 0.2 EP + 0,8 ER; 0.1 AC+0.9 ER; ER}
where ER=qualification obtained in the extra exam.

EXAMINATION RULES.

In the written partial and final exams, students may not bring any type of material, except that indicated by the teachers a few days before the exam.

BIBLIOGRAPHY

Basic:
- Audin, M. Geometry. Berlin: Springer Verlag, 2003. ISBN 3540434984.
- Berger, M. Geometry (vol.1; vol.2). Berlin: Springer Verlag, 1987. ISBN 3540116583.
- Hernández, Eugenio. Álgebra y geometría. 2ª ed. Addison-Wesley Iberoamericana/UAM, 1994. ISBN 8478290249.
- Castellet, M.; Llerena, I. Àlgebra lineal i geometria. 4a ed. Publicacions de la UAB, 2000. ISBN 847488943X.
- Reventós, Agustí. Affine maps, euclidean motions and quadrics [on line]. London: Springer, 2011 [Consultation: 26/06/2023]. Available on: https://link-springer-com.recursos.biblioteca.upc.edu/book/10.1007/978-0-85729-710-5. ISBN 9780857297099.

Complementary:
- Coxeter, H.S.M. Introduction to geometry. 2nd ed. John Wiley and Sons, 1969. ISBN 0471182834.
- Xambó, S. Geometria [on line]. 2a ed. Barcelona: Edicions UPC, 2001 [Consultation: 21/05/2020]. Available on: http://hdl.handle.net/2099.3/36176. ISBN 8483015110.
- Hartshorne, R. Geometry : euclid and beyond. Springer-Verlag, 2005. ISBN 0387986502.
- Silvester, J.R. Geometry : ancient and modern. Oxford University Press, 2001. ISBN 9780198508250.