FACULTY OF **ENGINEERING**

DEGREE COURSE: **COMPUTER AND CONTROL ENGINEERING BS**

**SUBJECT**: COMPLEMENTS OF MATHEMATICS

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## OBJECTIVES

The course should give the knowledge of Analytic Geometry and Linear Algebra needed to satisfactorily understand subsequent courses.

## CONTENTS

At the end of the didactic itinerary the student should be able to:
to define a vector space,
to solve linear systems by means of matrices,
to compute the eigenvalues and the eigenvectors of a matrix,
to diagonalize a matrix,
to define an affine space,
to define the projective space,
to write lines and planes by means of vector, parametric and Cartesian equations,
to define the scalar and vector product,
to solve problems involving lines and planes in the Euclidean space,
to study plane curves, in particular conics,
to define the polar duality of a non-degenerate conic,
to study surfaces, in particular quadrics.

## LEARNING OUTCOMES

**LINEAR ALGEBRA**

**Vector spaces**

- Definition. Linear dependence and independence of vectors. Bases and dimension of a vector space. Subspaces. The space of Euclidean vectors. Linear maps.

**Matrices**

- Definition. Operations. Determinant. Rank of a matrix. Transpose and inverse of a matrix. Linear maps and matrices. Eigenvalues and eigenvectors. Diagonalization.

**Linear systems**

- Definitions. Homogeneous and non-homogeneous linear systems. Gaussian elimination. Cramer systems.

**ANALYTIC GEOMETRY**

**Affine space**

- Definition. Coordinates. Vector, parametric and Cartesian equations of lines. Conditions of parallelism. Pencils. Coplanarity. Affine maps.

**Euclidean space**

- Definition. Cartesian coordinate systems. Scalar product. Distance. Orthogonality. Angles. Vector product.

**Projective space**

- Definition. Elements at infinity and projective extension of the plane and the space. Homogeneous coordinates. Equations of lines and planes.

**Curves**

- Definition. Conics. Pencils. Polar duality. Classification.

**Surfaces**

- Definition. Quadrics. Classification.

## ASSESSMENT

Written exam: multiple choice and open questions

## RECOMMENDED TEXTBOOKS

Further readings can be useful but are not mandatory.

- Wikipedia: http://en.wikipedia.org/
- Wikibooks: http://en.wikibooks.org/
- Linear Algebra (wikibooks): http://en.wikibooks.org/wiki/Linear_algebra

Wikipedia and Wikibooks can be enough as textbooks, however other free online books are as follows:

- http://www.freebookcentre.net/Mathematics/Linear-Algebra-Books.html
- http://www.e-booksdirectory.com/listing.php?category=46
- http://www.e-booksdirectory.com/listing.php?category=40

- Kenneth Kuttler, An Introduction To Linear Algebra
- Kenneth Kuttler, Linear Algebra
- Ruslan A. Sharipov, Course of analytical geometry (http://arxiv.org/abs/1111.6521)

Other suggested textbooks:

- Seymour Lipschutz – Marc Lipson, Linear Algebra (Schaum's Outline Series), McGraw-Hill
- Serge Lang, Introduction to Linear Algebra, Springer