BACHELOR 'S PROGRAMME
2nd YEAR OF STUDY, 2nd SEMESTER

COURSE TITLE	ALGEBRA AND ELEMENTS OF GEOMETRY
COURSE CODE	
COURSE TYPE	full attendance
COURSE LEVEL	1st cycle (bachelor's degree)
YEAR OF STUDY, SEMESTER	2nd year of study, 2nd semester
NUMBER OF ECTS CREDITS	5
NUMBER OF HOURS PER WEEK	4 (2 lecture hours + 2 seminar / laboratory hours)
NAME OF LECTURE HOLDER	Prof. Ioan Bucataru
NAME OF SEMINAR HOLDER	Prof. Ioan Bucataru
PREREQUISITES	Advanced level of English language

A COURSE-SPECIFIC COMPETENCES

Course-specific competences:

→ To identify and use in a proper manner the physical laws and principles in a given context.

→ Solving physical problems with given data using mathematica technics.

B LEARNING OUTCOMES

After finalizing with succes this discipline, students will be able:

→ To respresent and explain the differences between various representations, with respect to basis/frames, of the notions ackuired: vectors, linear transformations, straight-lines, planes, conics;

→ Describe at least one way of choosing a base/frame in a given vector space and use it associate a set of coordinates to r a vectorial/tensorial quantity

→ Use the instruments and the techniques offerred by linear algebra and analytic geometry to formulate and solve practical physical problems

→ Analise various experimental data using the techniques offerred by linear algebra (identify the quantities that are invariant to frame change and understad the meaning of this invarriants)

→ To compute algebraic or geometric invariants associated to vectorial/matrix quantities: distance, area, volume, eigenvalues, eigenvectors.

C LECTURE CONTENT

- Real vector spaces, vector subspaces, linear dependence and independence, systems of generators.
- Dimensions for vector spaces, Grasmann's theorem.
- Basis and coordinate changes, orientability of a vector space.
- Linear transformations, rank theorem, the matrix (equations) of a linear transformation.
- The dual of a vector space, tensor product, tensors.
- Eigenvectors and eigenvalues, the diagonalizability problem. The general theorem for diagonalizability.
- Euclidean vector spaces, scalar product, the norm of a vector, classic inequalities (Cauchy-Buniakovski-Schwartz, Minkowski), Gram-Schmidt algorithm for orthonormalization, orthogonal group.
- Free vectors, definition, properties, sum of free vectors, and product with real scalars, scalar product.
- Change of orthogonal basis, orthogonal transformations.
- Vector product of two free vectors, mixt product of three free vectors, double vector product.
- Orthonormal frames in plane and space, change of orthonormal frames, distance between two pints, distance from a point to a straight-line/plane, volume of a tetrahedron, distance between two straight-lines.
- Equations for a straight-line in plane and space, equations for a plane in space, relative positions.
- Conics in plane, conics on reduced equations, general equations of a conic, center of a conic.
- Principal directions, symmetry axes, canonical equations for a conic.

D RECOMMENDED READING FOR LECTURES

1. Gilbert Strang, Introduction to linear algebra, Wesley-Cambridge Press, 2016.
2. Artur Sulivan Gale and Percey Franklin Smith, Introduction to analytic geometry,
3. I. Pop, Gh. Neagu, "Algebră liniară şi geometrie analitică în plan şi spaţiu", Ed. Plumb, Bacău, 1996.

E SEMINAR / LABORATORY CONTENT

- Matrixes, determinants, system of linea equations
- Vector spaces and subspaces, operations with vector subspaces. Grasmann's Theorem.
- Linear dependence and independence, systems of generators.
- Bases and coordinates, changes of bases and coordinates.

	• Linear transformations, the matrix and equations of a linear transformation. • Eigenvectors and eigenvalues, diagonalization. • Scalar product, Cauchy-Buniakowski-Schwartz inequality, Gramm-Schmidt algorithm. • Free vectors, operations, the structure of vector space. • Scalar product of free vectors, orthonormal bases, ortogonal transformations. • Vector product, mixt product and double vector product. • Orthonormal frames, distance, area and volume. • Equations for straight-lines in plane and space, relative positions. • Equations for planes. • Symmetry aspects for conics, canonical equations.
F	RECOMMENDED READING FOR SEMINARS
	1. Ioan Bucataru, “Problems for linear algebra and analytic geometry”, www.math.uaic.ro/bucataru 2. Gilbert Strang, Introduction to linear algebra, Wesley-Cambridge Press, 2016. 3. M. Craioveanu, I.D. Albu, “Elemente de geometrie afină şi euclidiană”, Ed. Facla, Timişoara, 1982.
G	EDUCATION STYLE
LEARNING AND TEACHING METHODS	exposition/dialogue
ASSESSMENT METHODS	• written and oral evaluation
LANGUAGE OF INSTRUCTION	English