University **POLITEHNICA** of Bucharest (**UPB**)
Faculty of **Industrial Engineering and Robotics** (**FIIR**)
Study Programme: **Industrial Engineering** (**IE**)
Form of study: Licence (Bachelor)

COURSE SPECIFICATION

Course title:	Linear Algebra, Analytic and Differential Geometry	***Semester:***	1
Course code:	UPB.06.F.01.O.003	***Credits (ECTS):***	5

Course structure	**Lecture**	**Seminar**	Laboratory	Project	**Total hours**
Number of hours per week	2	2	-	-	4
Number of hours per semester	28	28	-	-	56

Lecturer	**Lecture**	**Seminar** / Laboratory / Project
Name, academic degree	Vladimir BALAN, Professor	Simona DINU, Lecturer
Contact (email, location)	vladimir.balan@upb.ro	simona.dinu@upb.ro

Course description:

At its root, linear algebra is the study of systems of linear equations. Systems of linear equations are ubiquitous in the natural and social sciences. Major contributions to the topic waere made by Gauss, Cauchy, Sylvester and Cayley - who developed the concept of a matrix - the most convenient language for the theory and practice of linear equations. Matrices are intricate algebraic objects with many fascinating properties, but they also provide a bridge between linear equations and vectors, so infusing the subject of linear algebra with a strong geometric flavor. We will delve into topics like spectral data, quadratic forms and signature, special linear mappings and isometries. As well, we shall introduce basic notions and methods of 3D-analytic geometry, and of differential geometry (essentials of curves and surfaces in 2D and in 3D).
This course includes the study of vectors in the plane and in space, systems of linear equations, matrices, determinants, real and abstract vector spaces, subspaces and linear transformations, basis and change of basis, inner products and orthogonality, eigenvalues and eigenvectors, similarity, diagonalization, quadratic forms, and algebraic varieties of first two orders (straight lines, planes, conics, quadrics, curves and surfaces).
The covered topics are useful in other disciplines such as physics, economics and social sciences, natural sciences, and engineering. It parallels the combination of theory and applications, and the subjects are presented with an applicative emphasis and are addressing the basic theorems.

Seminar / Laboratory / Project description:

The provided text and the class discussions introduce the concepts, methods, applications, and logical arguments of Linear Algebra, Analytic Geometry and basic Differential Geometry; the students will practice them and solve problems on daily assignments, and they will be tested on quizzes, midterms, and the final exam. The main addressed subjects are vectors in the plane and space, systems of linear equations, matrices, determinants, real and abstract vector spaces, subspaces and linear transformations, basis and change of basis, inner products and orthogonality, eigenvalues and eigenvectors, similarity, diagonalization, quadratic forms, and straight lines, planes, conics, quadrics, curves and surfaces.

Intended learning outcomes:

The present course aims to fulfill the following learning outcomes:

- To provide students with a good understanding of the concepts and methods of linear algebra, analytic geometry and differential geometry, described in detail in the syllabus.
- To help the students develop the ability to solve problems using linear algebra.

- To connect linear algebra to other fields both within and without mathematics.
- To develop abstract and critical reasoning by studying logical proofs and the axiomatic method as applied to linear algebra.

Students will be able to apply the concepts and methods described in the syllabus, they will be able to solve problems using linear algebra, they will know a number of applications of linear algebra, and they will be able to follow and elaborate related logical arguments.

Assessment method:	% of the final grade	Minimal requirements for award of credits
Written exam	40%	20%
Report / project	-	-
Homework	20%	10%
Seminar	40%	20%
Other	-	-

References:

Compulsory reading

[1] C. Udrişte, *V. Balan*, *Linear Algebra and Analysis* (in English), Ed. Geometry Balkan Press, Bucureşti 2001.

[2] C. Udrişte, *V. Balan*, *Analytic and Differential Geometry* (in English), Geometry Balkan Press, Bucureşti, 1999.

[3] *V. Balan*, I.R. Nicola, *Linear Algebra, Applications of linear algebra, analytic & differential geometry, differential equations. Solved problems and software programs* (in English), Ed. Printech, Bucureşti 2011.

[4] L.Smith, Linear Algebra, Springer Verlag, 1978.

[5] *V. Balan*, *Algebră liniară, geometrie analitică*, Ed. Fair Partners, Bucureşti, 1999.

[6] M.V.Sweet, *Algebra, Geometry and Trigonometry in Science, Engineering and Mathematics*, Ellis Horwood, 1984.

Optional reading

[1] P.V.O'Neill, *Advanced Engineering Mathematics*, Wadsworth Eds., 1991.

[2] P.H.Selby, *Practical Algebra*, John Wiley & Sons, 1974.

[3] *V. Balan*, M. Pîrvan, Matematici avansate pentru ingineri, Ed. Politehnica Press, Bucureşti 2019.

[4] *V. Balan*, M. Postolache, A. Pitea; Calcul matrceal şi metode numerice, Ed. Matrix Rom, Bucureşti 2013.

[5] C.Radu, L.Drăguşin, C.Drăguşin, *Algebră liniară, analiză matematică. Geometrie analitică şi diferenţială*, Ed. Fair Partners, Bucureşti, 2000.

[6] C.Udrişte, *Algebră liniară, geometrie analitică*, Geometry Balkan Press, Bucureşti, 2005.

[7] C.Udrişte, *Aplicaţii de algebră, geometrie şi ecuaţii diferenţiale*, Ed. Did. Ped., Bucureşti, 1993.

[8] C. Udrişte, *V. Balan*, C. Frigioiu, M. Roman, Algebră liniară, geometrie analitică, geometrie diferenţială şi elemente de analiză tensorială (vol.2), Ed. Studis, Vatra Dornei, 2013; http://www.edumanager.ro/community/documente/geometrie.pdf

Prerequisites:	***Co-requisites*** ***(courses to be taken in parallel as a condition for enrolment):***
College Algebra, Analytic Geometry and Analysis	

Additional relevant information:

Good knowledge of basic level matrix theory and of linear systems is compulsory.

Date: 14 May 2022

Prof.dr. Vladimir BALAN