MODULE DESCRIPTION

Module code	full-time studies:	**Z-ZIP1-E-102**
	part-time studies:	**Z-ZIPN1-E-102**
Module name	**Linear Algebra**	
Module name in Polish	**Algebra liniowa**	
Valid from academic year	**2019/2020**	

MODULE PLACEMENT IN THE SYLLABUS

Field of study	**MANAGEMENT AND PRODUCTION ENGINEERING**
Level of education	**1st degree**
Studies profile	**General**
Form and method of conducting classes	**Full-time and Part-time**
Specialisation	**All**
Unit conducting the module	**Department of Mathematics and Physics**
Module co-ordinator	**Beata Maciejewska, PhD, DSc**
Approved by:	**Dariusz Bojczuk, PhD, DSc**

MODULE OVERVIEW

Type of subject / group of subjects	**Basic**
Module status	**Compulsory**
Language of conducting classes	**English**
Module placement in the syllabus - semester	**Semester I**
Initial requirements	**No requirements**
Examination (YES/NO)	**NO**
Number of ECTS credit points	**2**

Method of conducting classes		Lecture	Classes	Laboratory	Project	Other
Per semester	full-time studies:	**15**	**15**			
	part-time studies:	**9**	**9**			

TEACHING RESULTS AND THE METHODS OF ASSESSING TEACHING RESULTS

Category	Symbol	Learning outcomes	Assignations to the directional learning outcomes
Knowledge	W01	A student has knowledge of complex numbers, matrix analysis and calculus of vectors, the methods of solving linear equations and analytic geometry.	ZIP1_W01
Skills	U01	A student can apply matrix calculus to solve matrix equations and to solve systems of linear equations.	ZIP1_U14
	U02	A student can evaluate the usefulness of familiar methods concerning solving equations and systems of linear equations; a student is also able to select the appropriate method in order to solve a system of equations.	ZIP1_U14
	U03	A student is able to geometrically interpret the basic concepts of complex numbers, knows how to perform calculations in the set of complex numbers, and solve equations in the complex domain.	ZIP1_U14
	U04	A student is able to geometrically interpret solutions of linear equations systems. He can connect the basic concepts of analytical geometry with vector calculus.	ZIP1_U14
Social competences	K01	A student understands the need to improve the acquired skills and knowledge. A student can comprehend the elementary relationship between the workload and its effect.	ZIP1_U14
	K02	A student is aware of the responsibility for his/her own work and is ready to comply with the rules of team work and to bear the consequences of the tasks completed collectively.	ZIP1_K01

TEACHING CONTENTS

Method of conducting classes	Teaching contents
Lecture	Matrices: types of matrices, operations and calculations on matrices and their properties. Determinant of a quadratic matrix: the notion of a matrix determinant and basic properties. Laplace`s rule. Inverse matrix. Solving matrix equations. Systems of linear equations. Cramer's rule. Matrix method of solving Cramer's systems. Solving systems of equations with the elementary operations method. Vectors in space. Operations on vectors. Dot product of vectors. Cross product of vectors. Analytic geometry in the three-dimensional space: a straight line and plane in space. Relative position of points, straight lines and planes. Complex numbers. Rectangular form of a complex number and calculations on the set of complex numbers. Polar form of a complex number – geometric interpretation. Euler`s formula. De Moivre's formula. A root of complex number. Solving polynomial equations in a complex domain.

	Matrices: operations on matrices and the properties of operations. Matrix determinant – the definition and basic properties. Inverse matrix and its application in solving matrix equations. Systems linear equations. The application of determinants in solving systems of linear equations (Cramer's rule). Matrix method of solving Cramer's systems. Solving systems of equations with the elementary operations method. Operations on vectors in space. Dot and cross products of vectors. The description of a straight line and a plane in space. Investigation of the mutual position of points, lines and planes in space. Complex numbers in an rectangular form and basic operations on complex numbers. Geometric interpretation of a complex number. A root of complex number. Solving polynomial equations in a complex domain.
Classes	

METODS OF ASSESSING TEACHING RESULTS

Symbol	Methods of checking the learning outcomes *(select X)*					
	Oral exam	Written exam	Test	Project	Statement	Other
W01			X			
U01			X			
U02			X			
U03			X			
U04			X			
K01						X
K02						X

FORM AND CONDITIONS OF PASSING

Form of classes	Form of credit	Passing conditions
Lecture	Credit with grade	Obtaining at least 50% of test points
Classes	Credit with grade	Obtaining at least 50% of test points during the class

STUDENT WORKLOAD

<table>
<tr><td colspan="10" align="center">Balance of ECTS points</td></tr>
<tr><td rowspan="3">No.</td><td rowspan="3">Type of student's activity</td><td colspan="10" align="center">Student's workload</td><td rowspan="3">Unit</td></tr>
<tr><td colspan="5" align="center">full-time</td><td colspan="5" align="center">part-time</td></tr>
<tr><td>Lc</td><td>C</td><td>Lb</td><td>P</td><td>O</td><td>Lc</td><td>C</td><td>Lb</td><td>P</td><td>O</td></tr>
<tr><td>1.</td><td>Participation in the activities</td><td>15</td><td>15</td><td></td><td></td><td></td><td>9</td><td>9</td><td></td><td></td><td></td><td>h</td></tr>
<tr><td>2.</td><td>Other (consultation, exam)</td><td>2</td><td>2</td><td></td><td></td><td></td><td>2</td><td>2</td><td></td><td></td><td></td><td>h</td></tr>
<tr><td>3.</td><td>Number of hours of a student's assisted work</td><td colspan="5" align="center">34</td><td colspan="5" align="center">22</td><td>h</td></tr>
<tr><td>4.</td><td>Number of ECTS credit points which are allocated for assisted work</td><td colspan="5" align="center">1,4</td><td colspan="5" align="center">0,9</td><td>ECTS</td></tr>
<tr><td>5.</td><td>Number of hours of a student's unassisted work</td><td colspan="5" align="center">16</td><td colspan="5" align="center">28</td><td>h</td></tr>
<tr><td>6.</td><td>Number of ECTS credit points which a student receives for unassisted work</td><td colspan="5" align="center">0,6</td><td colspan="5" align="center">1,1</td><td>ECTS</td></tr>
<tr><td>7.</td><td>Work input connected with practical classes</td><td colspan="5" align="center">25</td><td colspan="5" align="center">25</td><td>h</td></tr>
<tr><td>8.</td><td>Number of ECTS credit points which a student receives for practical classes</td><td colspan="5" align="center">1,0</td><td colspan="5" align="center">1,0</td><td>ECTS</td></tr>
<tr><td>9.</td><td>Total number of hours of a student's work</td><td colspan="5" align="center">50</td><td colspan="5" align="center">50</td><td>h</td></tr>
<tr><td>10.</td><td>Punkty ECTS za moduł
<i>1 ECTS=25 hours</i></td><td colspan="10" align="center">2</td><td>ECTS</td></tr>
</table>

LITERATURE

1. Anton H., Rorres Ch. (2010), *Elementary linear algebra*, John Wiley & Sons (Available online).
2. Simmons G.F. (1996), *Calculus with analytic geometry*, MC-Graw-Hill (Available online).
3. Torrence B.F., Torrence E.A. (2009),*The student's introduction to Mathematica: a handbook for precalculus, calculus, and linear algebra*, University Press, Cambridge.