



<b>COURSE: Linear Algebra</b>		
<b>DEGREE: Degree in Industrial Technologies</b>	<b>YEAR: 1</b>	<b>TERM: 1</b>
<i>The course has 28 lectures distributed along 14 weeks + an extra theoretical lecture on complex numbers</i>		

WEEKLY PLANNING								
WEEK	SESSION	DESCRIPTION	GROUPS (mark X)		Special room for session (computer classroom, audio-visual classroom...)	WEEKLY PROGRAMMING FOR STUDENT		
			LECTU RES	SEMIN ARS		DESCRIPTION	CLASS HOURS	HOMEWORK HOURS (Max. 7h week)
1	1	Systems of linear equations (Lay 1.1, see Notes at the end) <ul style="list-style-type: none"> <li>• Solution of a linear system</li> <li>• Matrix notation</li> <li>• Solving a linear system</li> <li>• Elementary row operations</li> <li>• Row equivalence</li> </ul> Row reduction and echelon form (Lay 1.2)	X			Study of the book (*1, see Notes at the end)	1,66	7

		<ul style="list-style-type: none"> <li>• Uniqueness theorem for the echelon form</li> <li>• Pivot positions</li> <li>• Gauss algorithms</li> <li>• Solutions of systems of equations</li> <li>• Uniqueness and existence theorem</li> </ul>						
1	2	Selected exercises (*2, see Notes at the end)		X		Odd exercises. Compare with solutions (*3, see Notes at the end)	1,66	
2	3	Vector equations (Lay 1.3) <ul style="list-style-type: none"> <li>• Vectors in <math>\mathbb{R}^n</math></li> <li>• Linear combinations</li> <li>• Spanned subspace</li> </ul> Matrix equation $Ax=b$ (Lay 1.4) <ul style="list-style-type: none"> <li>• Relationship with systems of equations</li> <li>• Linearity of the product <math>Ax</math></li> </ul>	X			Study of the book (*1)	1,66	7
2	4	Selected exercises (*2)		X		Odd exercises. Compare with solutions (*3)	1,66	
3	5	Structure of the solution of a system (Lay 1.5) <ul style="list-style-type: none"> <li>• Homogeneous linear systems</li> <li>• Inhomogeneous linear systems</li> </ul> Linear independence (Lay 1.7) <ul style="list-style-type: none"> <li>• Characterization of linearly dependent sets</li> </ul>	X			Study of the book (*1)	1,66	7
3	6	Selected exercises (*2)		X		Odd exercises. Compare with solutions (*3)	1,66	
4	7	Introduction to linear transformations (Lay 1.8) The matrix of a linear transformation (Lay 1.9) <ul style="list-style-type: none"> <li>• One-to-one and onto</li> </ul> Matrix operations (Lay 2.1) <ul style="list-style-type: none"> <li>• Sum and product by scalars</li> <li>• Matrix multiplication</li> </ul>	X			Study of the book (*1)	1,66	7

		<ul style="list-style-type: none"> <li>• Transpose of a matrix</li> </ul>						
4	8	Selected exercises (*2)		X		Odd exercises. Compare with solutions (*3)	1,66	
5	9	Inverse of a matrix (Lay 2.2) <ul style="list-style-type: none"> <li>• Relationship with the uniqueness of the solutions of <math>Ax=b</math></li> <li>• Properties</li> <li>• Characterization of invertible matrices</li> <li>• Algorithms to compute inverses.</li> </ul> Block structured matrices (Lay 2.4) <ul style="list-style-type: none"> <li>• Row column product</li> <li>• Column row product</li> <li>• Inverses of block structured matrices</li> </ul>	X			Study of the book (*1)	1,66	7
5	10	<b>Test on chapter 1.</b> Selected exercises (*2)		X		Odd exercises. Compare with solutions (*3)	1,66	
6	11	Introduction to determinants (Lay 3.1) <ul style="list-style-type: none"> <li>• Expansion in cofactors</li> <li>• Determinant of a triangular matrix</li> </ul> Properties of determinants (Lay 3.2) <ul style="list-style-type: none"> <li>• Row transformations</li> <li>• Determinant and invertibility</li> <li>• Determinant of a product of matrices</li> </ul> <b>EXTRA THEORETICAL LECTURE:</b> Complex numbers (Lay, Appendix B)	X			Study of the book (*1)	1,66	7
6	12	Selected exercises (*2)		X		Odd exercises. Compare with solutions (*3)	1,66	
7	13	Subspaces in $\mathbb{R}^n$ (Lay 2.8, 4.1)	X			Study of the book (*1)	1,66	7

		<ul style="list-style-type: none"> <li>Spanned subspace, spanning set</li> <li>Kernel and column space of a matrix (Lay 2.8, 4.2)</li> <li>Relationship of the kernel with the homogeneous system</li> <li>Parametric equations for the kernel</li> </ul>						
7	14	Selected exercises (*2)		X		Odd exercises. Compare with solutions (*3)	1,66	
8	15	Basis in $\mathbb{R}^n$ and in subspaces (Lay 2.9, 4.3) <ul style="list-style-type: none"> <li>Spanning set theorem</li> <li>Linear dependence relations in the columns of a matrix</li> <li>Basis for Col A and Nul A</li> </ul> Coordinate systems (Lay 2.9, 4.4) <ul style="list-style-type: none"> <li>Coordinate mapping as a bijection</li> </ul>	X			Study of the book (*1)	1,66	7
8	16	Selected exercises (*2)		X		Odd exercises. Compare with solutions (*3)	1,66	
9	17	Dimension of a vector space (Lay 2.9, 4.5) <ul style="list-style-type: none"> <li>Dimension theorem</li> <li>Basis theorem</li> <li>Dimensions of Nul A and Col A</li> </ul> Rank (Lay 4.6) <ul style="list-style-type: none"> <li>Rank theorem</li> </ul> Change of basis (Lay 4.7) <ul style="list-style-type: none"> <li>Change of basis matrix</li> </ul>	X			Study of the book (*1)	1,66	7
9	18	<b>Test on chapters 2, 3 and complex numbers.</b> Selected exercises (*2)		X		Odd exercises. Compare with solutions (*3)	1,66	
10	19	Eigenvalues and eigenvectors (Lay 5.1)	X			Study of the book (*1)	1,66	7

		<ul style="list-style-type: none"> <li>Linear independence of eigenvectors.</li> <li>Eigenspaces.</li> </ul> <p>The characteristic equation (Lay 5.2)</p> <ul style="list-style-type: none"> <li>Relationship with invertibility</li> <li>Similarity invariance.</li> </ul> <p>Matrix diagonalization (Lay 5.3)</p> <ul style="list-style-type: none"> <li>Fundamental theorem</li> <li>Diagonalization method</li> </ul>						
10	20	Selected exercises (*2)		X		Odd exercises. Compare with solutions (*3)	1,66	
11	21	<p>Scalar product, norm and orthogonality (Lay 6.1)</p> <ul style="list-style-type: none"> <li>Distance</li> <li>Orthogonal complement</li> </ul> <p>Orthogonal sets (Lay 6.2)</p> <ul style="list-style-type: none"> <li>Linear independence</li> <li>Orthogonal and orthonormal basis</li> <li>Coordinates in orthogonal basis</li> <li>Orthogonal matrices</li> </ul>	X			Study of the book (*1)	1,66	7
11	22	Selected exercises (*2)		X		Odd exercises. Compare with solutions (*3)	1,66	
12	23	<p>Orthogonal projections (Lay 6.3)</p> <ul style="list-style-type: none"> <li>Orthogonal decomposition theorem</li> <li>Best approximation theorem</li> <li>Orthogonal projection matrix</li> </ul>	X			Study of the book (*1)	1,66	7
12	24	Selected exercises (*2)		X		Odd exercises. Compare with solutions (*3)	1,66	
13	25	<p>Gram-Schmidt method (Lay 6.4)</p> <p>QR factorization (Lay 6.4)</p>	X			Study of the book (*1)	1,66	7

		Least-squares problems (Lay 6.5)						
		<ul style="list-style-type: none"> <li>• Solution with projections</li> <li>• Normal equations</li> </ul>						
13	26	Selected exercises (*2)		X		Odd exercises. Compare with solutions (*3)	1,66	
14	27	Diagonalization of symmetric matrices (Lay 7.1)	X			Study of the book (*1)	7	
		<ul style="list-style-type: none"> <li>• Real character of eigenvalues</li> <li>• Orthogonality of eigenvectors</li> <li>• Spectral theorem</li> </ul>						
14	28	<b>Test on chapters 4,5 and 6.</b>		X		Odd exercises. Compare with solutions (*3)	1,66	
		Selected exercises (*2)						
<b>Subtotal 1</b>							<b>46,66</b>	<b>98</b>
<b>Total 1 (Hours of class plus student homework hours between weeks 1-14)</b>								

15		Tutorials, handing in, etc					7	
16		Preparation for evaluations, assessment Final exam						
17						3,33	7	
18								
<b>Subtotal 2</b>							<b>3,33</b>	<b>14</b>
<b>Total 2 (Hours of class plus student homework hours between weeks 15-18)</b>								

<b>TOTAL (Total 1 + Total 2)</b>							<b>162</b>
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Notes:

(Lay 1.3) Section of D. C. Lay's book containing the material covered in the corresponding session.

(\*1) Study the corresponding sessions in D. C. Lay's book.

(\*2) Selected exercises from D. C. Lay's book corresponding to the previous lecture in large group.

(\*3) Do some of the odd exercises in D. C. Lay's book corresponding to the previous lecture in large group and compare with the solutions in the book.