Universidad Carlos III de Madrid
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COURSE: Linear Algebra		
DEGREE: Degree in Telematics Engineering	**YEAR: 1**	**TERM: 1**
The course has 28 lectures distributed along 14 weeks + an extra theoretical lecture on complex numbers		

WEEKLY PLANNING

WEEK	SESSION	DESCRIPTION	GROUPS (mark X)		Special room for session (computer classroom, audio-visual classroom…)	WEEKLY PROGRAMMING FOR STUDENT		
			LECTURES	SEMINARS		DESCRIPTION	CLASS HOURS	HOMEWORK HOURS (Max. 7h week)
1	1	Systems of linear equations (Lay 1.1, see Notes at the end) • Solution of a linear system • Matrix notation • Solving a linear system • Elementary row operations • Row equivalence Row reduction and echelon form (Lay 1.2)	X			Study of the book (*1, see Notes at the end)	1,66	7

		• Uniqueness theorem for the echelon form • Pivot positions • Gauss algorithm • Solutions of systems of equations • Uniqueness and existence theorem						
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) • Vectors in R^n • Linear combinations • Spanned subspace Matrix equation Ax=b (Lay 1.4) • Relationship with systems of equations • Linearity of the product A x	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 of equations (Lay 1.5) • Homogeneous linear systems • Inhomogeneous linear systems Linear independence (Lay 1.7) • Characterization of linearly dependent sets	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) • One-to-one and onto mappings Matrix operations (Lay 2.1) • Sum and product by scalars • Matrix multiplication	X			Study of the book (*1)	1,66	7

		• Transpose of a matrix						
4	8	Selected exercises (*2)		X		Odd exercises. Compare with solutions (*3)	1,66	
5	9	Inverse of a matrix (Lay 2.2) • Relationship with the uniqueness of the solutions of Ax=b • Properties • Characterization of invertible matrices • Algorithm to compute inverses. Partiotioned matrices (Lay 2.4) • Row column product • Column row product • Inverses of partitioned matrices	X			Study of the book (*1)	1,66	7
5	10	**Test on chapter 1.** Selected exercises (*2)		X		Odd exercises. Compare with solutions (*3)	1,66	
6	11	Introduction to determinants (Lay 3.1) • Expansion in cofactors • Determinant of a triangular matrix Properties of determinants (Lay 3.2) • Row transformations • Determinant and invertibility • Determinant of a product of matrices **EXTRA THEORETICAL LECTURE**: Complex numbers (Lay, Appendix B and additional material available in AULA GLOBAL)	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 R^n (Lay 2.8, 4.1)	X			Study of the book (*1)	1,66	7

		• Spanned subspace, spanning set • Kernel and column space of a matrix (Lay 2.8, 4.2) • Relationship of the kernel with an homogeneous system • Parametric equations for the kernel						
7	14	Selected exercises (*2)		X		Odd exercises. Compare with solutions (*3)	1,66	
8	15	Basis in R^n and in subspaces (Lay 2.9, 4.3) • Spanning set theorem • Linear dependence relations in the columns of a matrix • Basis for Col A and Nul A Coordinate systems (Lay 2.9, 4.4) • Coordinate mapping as a bijection	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) • Dimension theorem • Basis theorem • Dimensions of Nul A and Col A Rank (Lay 4.6) • Rank theorem Change of basis (Lay 4.7) • Change of basis matrix	X			Study of the book (*1)	1,66	7
9	18	**Test on chapters 2, 3 and complex numbers.** 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

		• Linear independence of eigenvectors. • Eigenspaces. The characteristic equation (Lay 5.2) • Relationship with invertibility • Similarity invariance. Matrix diagonalization (Lay 5.3) • Fundamental theorem • Diagonalization method						
10	20	Selected exercises (*2)		X		Odd exercises. Compare with solutions (*3)	1,66	
11	21	Scalar product, norm and orthogonality (Lay 6.1) • Distance • Orthogonal complement Orthogonal sets (Lay 6.2) • Linear independence • Orthogonal and orthonormal basis • Coordinates in orthogonal basis • Orthogonal matrices	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	Orthogonal projections (Lay 6.3) • Orthogonal decomposition theorem • Best approximation theorem • Orthogonal projection matrix	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	Gram-Schmidt method (Lay 6.4) QR factorization (Lay 6.4)	X			Study of the book (*1)	1,66	7

		Least-squares problems (Lay 6.5) • Solution with projections • Normal equations						
13	26	Selected exercises (*2)		X		Odd exercises. Compare with solutions (*3)	1,66	
14	27	Diagonalization of symmetric matrices (Lay 7.1) • Real character of eigenvalues • Orthogonality of eigenvectors • Spectral theorem	X			Study of the book (*1)		7
14	28	**Test on chapters 4,5 and 6.** Selected exercises (*2)		X		Odd exercises. Compare with solutions (*3)	1,66	
						Subtotal 1	**46,66**	**98**
		Total 1 *(Hours of class plus student homework hours between weeks 1-14)*						

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

TOTAL *(Total 1 + Total 2)*	**162**

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.