

Course guide 230904 - ALN - Linear Algebra

Last modified: 19/06/2024

Unit in charge: Teaching unit:	Barcelona School of Telecommunications Engineering 749 - MAT - Department of Mathematics.		
Degree:	BACHELOR'S DEGREE IN E (Compulsory subject).	LECTRONIC ENGINEERING AND TELECOMMUNICATION (Syllabus 2018).	
Academic year: 2024	ECTS Credits: 6.0	Languages: Catalan, Spanish	

LECTURER	
Coordinating lecturer:	FRANCISCO JAVIER MUÑOZ LOPEZ
Others:	Primer quadrimestre: FRANCISCO JAVIER MUÑOZ LOPEZ - 10

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

CE3. (ENG) GREELC:Comprensió i domibbi dels conceptes bàsics sobre les lleis generals de la macànica, termodinàmica, camps i ones i electromagnetisme i la seva aplicació per a la resolució de problmes propis de l'enginyeria. (Mòdul de formació bàsica).

Generical:

2. ABILITY TO IDENTIFY, FORMULATE AND SOLVE ENGINEERING PROBLEMS Level 1.To identify the complexity of the problems presented in the subjects. To set out correctly the problem correctly from the statements suggested. To identify the possible options for its resolution. To choose an option, apply it and to identify the need to change it in case of fail. To provide tools and methods to test whether the solution is correct or at least consistent. To identify the role of creativity in science and technology CG3. (ENG) GREELEC: Coneixmetn de matèries bàsiques i tecnològíes que el capacitin per a l'aprenentatge de nous mètodes i tecnologies, així com que el dotin d'una gran versatilitat per adaptar-se a noves situacions.

Transversal:

1. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.

CT6. (ENG) GREELEC: APRENENTATGE AUTÒNOM: Detectar deficiències en el propi coneixement i superarles mitjançant la reflexió crítica i l'elecció de la millor actuació per ampliar coneixements.

Basic:

CB5. (ENG) GREELEC: Que els estudiants pugin desenvolupar habillitats d'aprenentatge per empendre estudis superiors amb un alt grau d'autonomia.

TEACHING METHODOLOGY

Application lectures Expositive lectures Personal work (non classroom) Short-answer questions (Test) Proves de resposta llarga (Examen Final)



LEARNING OBJECTIVES OF THE SUBJECT

To introduce the basic concepts of linear algebra.

Learning outcome:

He/she expresses clearly the process of planning and solving exercises and problems that require the use of linear algebra.

He/she understands and masters the most useful methods to solve problems in the area of this subject.

He/she addresses numerical description and formulation of problems with descriptive description.

He/she makes use of more than one source and uses it in a complementary manner to observe the events described in the main text. He/she identifies problems and models from open situations and explores alternative resolutions.

STUDY LOAD

Туре	Hours	Percentage
Self study	85,0	56.67
Hours large group	65,0	43.33

Total learning time: 150 h

CONTENTS

(ENG) Tema 1. Complex numbers

Description:

Algebraic Structures.

Definition, and properties of complex numbers. Real and imaginary part, module and argument. Conjugate. Euler's formula. Binomial, polar, exponential representation. Roots and powers of complex numbers.

Related competencies :

08 CRPE N1. ABILITY TO IDENTIFY, FORMULATE AND SOLVE ENGINEERING PROBLEMS Level 1.To identify the complexity of the problems presented in the subjects. To set out correctly the problem correctly from the statements suggested. To identify the possible options for its resolution. To choose an option, apply it and to identify the need to change it in case of fail. To provide tools and methods to test whether the solution is correct or at least consistent. To identify the role of creativity in science and technology

07 AAT N1. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.

Full-or-part-time: 11h Theory classes: 5h Self study : 6h



(ENG) Tema 2. Matrices and determinants.

Description:

Matrices and sub-matrices. Operations and properties. Elementary transformations. Echelon forms. Rank of a matrix. Inverse matrix. Systems of linear equations. Discussion and resolution of systems. Gaussian elimination. Gauss-Jordan elimination. Determinants: definition and properties. Calculation of determinants. Orthogonal matrices. Minors and calculating the rank of a matrix by minors. Cramer's rule. Traces and cofactors. Laplace's formula. Adjugate matrix. **Related competencies :**

Related competencies :

08 CRPE N1. ABILITY TO IDENTIFY, FORMULATE AND SOLVE ENGINEERING PROBLEMS Level 1.To identify the complexity of the problems presented in the subjects. To set out correctly the problem correctly from the statements suggested. To identify the possible options for its resolution. To choose an option, apply it and to identify the need to change it in case of fail. To provide tools and methods to test whether the solution is correct or at least consistent. To identify the role of creativity in science and technology

07 AAT N1. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.

Full-or-part-time: 15h Theory classes: 7h Self study : 8h

(ENG) Tema 3. Vectorial spaces.

Description:

Definition, properties, and examples. Vector subspaces. Linear independence. Generating system, basis and dimension. Components and change of basis. Intersection, sum and direct sum. Grassmann formula. The four subspaces associated to a matrix.

Related competencies :

08 CRPE N1. ABILITY TO IDENTIFY, FORMULATE AND SOLVE ENGINEERING PROBLEMS Level 1.To identify the complexity of the problems presented in the subjects. To set out correctly the problem correctly from the statements suggested. To identify the possible options for its resolution. To choose an option, apply it and to identify the need to change it in case of fail. To provide tools and methods to test whether the solution is correct or at least consistent. To identify the role of creativity in science and technology

07 AAT N1. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.

Full-or-part-time: 25h Theory classes: 12h Self study : 13h



(ENG) Tema 4. Linear transformations.

Description:

Definition and properties. Associated matrix. Image and inverse image. Change of basis. Kernel and image. Rank-nullity theorem. Injective and exhaustive transformations. Endomorphisms. Change of basis.

Related competencies :

08 CRPE N1. ABILITY TO IDENTIFY, FORMULATE AND SOLVE ENGINEERING PROBLEMS Level 1.To identify the complexity of the problems presented in the subjects. To set out correctly the problem correctly from the statements suggested. To identify the possible options for its resolution. To choose an option, apply it and to identify the need to change it in case of fail. To provide tools and methods to test whether the solution is correct or at least consistent. To identify the role of creativity in science and technology

07 AAT N1. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.

Full-or-part-time: 24h

Theory classes: 11h Self study : 13h

(ENG) Tema 5. Euclidean space.

Description:

Inner product, norm, and angle. Cauchy-Schwarz and triangular inequalities, Pythagorean theorem. Orthogonality. Orthonormal and orthonormal basis. Change of basis. Positive definite matrices. Orthogonal complement. Orthogonal projection and best approximation. Gram-Schmidt method. Normal equations and Fourier coefficients. Best approximation for a linear system: least squares. Quadratic error. Overdetermines systems. Pseudoinverse matrix. Introduction to unitary space.

Related competencies :

08 CRPE N1. ABILITY TO IDENTIFY, FORMULATE AND SOLVE ENGINEERING PROBLEMS Level 1.To identify the complexity of the problems presented in the subjects. To set out correctly the problem correctly from the statements suggested. To identify the possible options for its resolution. To choose an option, apply it and to identify the need to change it in case of fail. To provide tools and methods to test whether the solution is correct or at least consistent. To identify the role of creativity in science and technology

07 AAT N1. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.

Full-or-part-time: 28h

Theory classes: 13h Self study : 15h



(ENG) Tema 6. Diagonalization of endomorphisms.

Description:

Eigenvectors and eigenvalues. Characteristic polynomial and traces of an endomorphism. Eigenspaces, algebraic and geometric multiplicities. Diagonalization conditions. Complex eigenvalues of real matrices. Symmetric endomorphisms. Orthogonal basis of eigenvectors. Orthogonal diagonalization of symmetric matrices. Spectral theorem. Singular value decomposition.

Related competencies :

08 CRPE N1. ABILITY TO IDENTIFY, FORMULATE AND SOLVE ENGINEERING PROBLEMS Level 1.To identify the complexity of the problems presented in the subjects. To set out correctly the problem correctly from the statements suggested. To identify the possible options for its resolution. To choose an option, apply it and to identify the need to change it in case of fail. To provide tools and methods to test whether the solution is correct or at least consistent. To identify the role of creativity in science and technology

07 AAT N1. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.

Full-or-part-time: 27h Theory classes: 12h Self study : 15h

ACTIVITIES

(ENG) Test (Test)

Description: First test

Full-or-part-time: 1h Theory classes: 1h

(ENG) Test (Test)

Description: Second test

Full-or-part-time: 1h Theory classes: 1h

(ENG) Exam (Final Exam)

Description: Final test

Full-or-part-time: 3h Theory classes: 3h



GRADING SYSTEM

Two tests along course: 40% Final exam: 60%

BIBLIOGRAPHY

Basic:

- Amer, R.; Carreras, F. Curs d'àlgebra lineal. 2a ed. Terrassa: Universitat Politècnica de Catalunya, 1998. ISBN 8484987841.
- Lay, D.C. Álgebra lineal y sus aplicaciones [on line]. 5a. ed. Madrid: Pearson Educación, 2016 [Consultation: 18/05/2020]. Available on: <u>http://www.ingebook.com/ib/NPcd/IB BooksVis?cod primaria=1000187&codigo libro=6765</u>. ISBN 9786073237451.
- Strang, G. Introduction to linear algebra. 6th ed. Wellesley, Mass.: Wellesley-Cambridge Press, 2023. ISBN 9781733146678.

Complementary:

- Amer, R; Sales, V. Àlgebra lineal: problemes resolts [on line]. Barcelona: Universitat Politècnica de Catalunya, 2009 [Consultation: 10/10/2022]. Available on: <u>http://mat-web.upc.edu/people/rafael.cubarsi/algebra/algebra-lineal-problemes-resolts.pdf</u>. ISBN 8476532768.

- Rojo García, J.; Martín, I. Ejercicios y problemas de álgebra lineal. 2a ed. Madrid: McGraw-Hill, 2004. ISBN 8448198581.