Course number and name	END 210 / Linear Algebra for Industrial Engineers
Credits, contact hours, categorization of credits	3 credits / 42 hours / Math and Basic Sciences
Instructor or course coordinator	C. Erhan BOZDAĞ, Erkan IŞIKLI
Text book and other supplemental materials	• Strang, G. (2005). *Linear Algebra and Its Applications*, 4th ed. USA: Cengage Learning. • Lay, D.C. (2012). *Linear Algebra and Its Applications*, 4th ed. USA: Pearson Education, Inc. • Blanco-Silva, F.J. (2013) Learning SciPy for Numerical and Scientific Computing, Packt Publishing.

Course information	
Content	Linear Equations and Matrices: Linear systems of equations, matrices, matrix product, algebraic properties of matrix operations, special matrices (square, symmetric, orthogonal, triangular, diagonal, etc.); Solving Linear Systems: Echelon form of a matrix and its rank, solving linear systems, elementary matrices, matrix inverses, equivalent matrices; Determinants: Definition and properties of the determinant, cofactor expansion and finding the inverse of a matrix, applications of the determinant, Cramer's rule; Real Vector Spaces: Vectors in two- and three-dimensional spaces, definition of a vector space, subspaces, spanning, linear independence, basis, dimension, orthonormalization (Gram-Schmidt process), projection matrix; Eigenvalues and eigenvectors: Diagonalization and the matrix power, positive definite and semi-definite matrices, the Singular Value Decomposition.
Prerequisites	MAT 104E Mathematics II
Type	Required

Course learning outcomes
Students who pass the course will: I. Solve systems of linear equations using multiple methods and interpret their results. II. Perform and interpret matrix operations, including inverses and determinants. III. Demonstrate an understanding of vector spaces and subspaces. IV. Demonstrate an understanding of linear independence, spanning sets, and bases. V. Demonstrate and understanding of eigenvalues and eigenvectors and solve eigenvalue problems. VI. Apply the principles of matrix algebra to linear transformations.

Student outcomes	Level of contribution
SO1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.	High
SO2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.	Little
SO3. An ability to communicate effectively with a range of audiences.	Not applicable
SO4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.	Little
SO5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.	Not applicable
SO6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.	Partial
SO7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	Partial

Week	Topics	Learning outcome(s)
1	Linear systems of equations, Matrices, Matrix product.	I
2	Algebraic properties of matrix operations, Special matrices.	II
3	Echelon form of a matrix and its rank, Solving linear systems.	I, II
4	Elementary matrices, Matrix inverses, Equivalent matrices.	II
5	Determinants and their properties, Cofactor expansion and matrix inverses.	II
6	Applications of the determinant, Cramer’s rule.	II
7	Vectors in two- and three-dimensional spaces, Vector spaces, Subspaces.	III
8	Spanning, Linear independence, Basis, and Dimension.	III, IV
9	Orthonormalization: The Gram-Schmidt process, Projection matrix and a statistical application (The Least Squares Method)	III, IV, V
10	Eigenvalues, Eigenvectors and their application in stochastic modeling (Markov transition matrix)	V
11	Diagonalization and matrix power. Positive definite and semi-definite matrices.	V
12	Singular Value Decomposition	V
13	Linear transformations and an application in image processing.	VI
14	Putting it all together: The Simplex Method.	I-VI