MATH 201 Linear Algebra with Engineering Applications

Course Code	Course Name	Semester	
MATH 201	Linear Algebra with Engineering Applications	Fall ☐ Spring ☒ Summer ☐	
Hours		**Credit**	**ECTS**
Theory	**Practice** / **Lab**	3	4
3	0 / 0		

Course Details	
Department	Computer Engineering
Course Language	English
Course Level	Undergraduate ☒ Graduate ☐
Mode of Delivery	Face to Face ☒ Online ☐ Hybrid ☐
Course Type	Compulsory ☒ Elective ☐
Lecturer (s)	
Course Objectives	This is an introductory course in linear algebra. The aim of this course is to teach you the mathematical fundamentals of linear algebra in a way that illustrates their relevance to computer science. This is a course in mathematics. But, in it, you will use the mathematical concept to illustrate facts about computers, and you will use computers to help you improve your understanding of the mathematics. You will also see how linear algebra is applied in various areas of computer science.
Course Content	Vectors, matrices, linear equations, vector spaces and subspaces, orthogonality, determinants, Eigenvalues and Eigenvectors, linear transformations, complex vectors and matrices, numerical linear algebra.
Course Method/ Techniques	Lecture ☒ Question & Answer ☒ Presentation ☐ Discussion ☐
Prerequisites/ Corequisites	

Work Placement(s)	

Textbook/References/Materials

- Materials:
  G. Strang, Introduction to Linear Algebra, 5th Ed., Wellesly-Cambridge Press, 2016.
  S. Lipschutz and M. Lipson, Schaum's Outline of Linear Algebra, 6th Edition. New York: McGraw-Hill Education, 2017.

Course Category				
Mathematics and Basic Sciences	☒		Education	☐
Engineering	☒		Science	☒
Engineering Design	☒		Health	☒
Social Sciences	☐		Profession	☐

Weekly Schedule

No	Topics	Materials/Notes
1	Introduction to vectors, vectors and linear combinations, algebraic properties, lengths and dot products, matrices	Handout Chapter 1
2	Solving linear equations, vectors and linear equations, elimination, row echelon form.	Handout Chapter 2
3	Solving linear equations, vectors and linear equations, elimination, row echelon form	Handout Chapter 3
4	Matrix operations, rules of matrix operations, independence, transposes, inverse matrices, factorization and permutations, cofactors, determinant, volumes	Handout Chapter 4
5	Matrix operations, rules of matrix operations, independence, transposes, inverse matrices, factorization and permutations, cofactors, determinant, volumes	Handout Chapter 4
6	Vector spaces and subspaces, null space, dimensions, vector independence	Handout Chapter 5
7	Orthogonality, least squares approximations, orthonormal bases and Gram-Schmidt	Handout Chapter 6
8	Midterm Exam	
9	Eigenvalues and eigenvectors, diagonalization, systems of differential equations	Handout Chapter 7
10	Eigenvalues and eigenvectors, diagonalization, systems of differential equations	Handout Chapter 7
11	Symmetric matrices, diagonalization of symmetric matrices, quadratic forms, positive definite matrices	Handout Chapter 8
12	Symmetric matrices, diagonalization of symmetric matrices, quadratic forms, positive definite matrices	Handout Chapter 8

13	Linear transformations (mapping), the matrix of a linear transformation	Handout Chapter 9
14	Complex vectors and matrices, complex numbers, systems with complex numbers, vector spaces	Handout Chapter 10
15	Eigenvectors and inner products in complex vector spaces, hermitian matrices and unitary diagonalization	Handout Chapter 11
16	Final Exam	

Assessment Methods and Criteria		
In-term studies	**Quantity**	**Percentage**
Attendance	-	-
Lab	-	-
Practice	-	-
Fieldwork	-	-
Course-specific internship	-	-
Quiz/Studio/Criticize	-	-
Homework	-	-
Presentation / Seminar	-	-
Project	-	-
Report	-	-
Seminar	-	-
Midterm Exam	1	40
Final Exam	1	60
	Total	**100%**
Contribution of Midterm Studies to Success Grade	1	40
Contribution of End of Semester Studies to Success Grade	1	60
	Total	**100%**

ECTS Allocated Based on Student Workload			
Activities	**Quantity**	**Duration (Hrs)**	**Total Workload**
Course Hours	16	3	48
Lab	-	-	-
Practice	-	-	-
Fieldwork	-	-	-
Course-specific Work Placement	-	-	-
Out-of-class study time	16	2	32
Quiz/Studio/Criticize	-	-	-
Homework	-	-	-
Presentation / Seminar	-	-	-
Project	-	-	-
Report	-	-	-
Midterm Exam and Preparation for Midterm	1	20	20
Final Exam and Preparation for Final Exam	1	25	25
Total Workload			**125**
Total Workload / 25			**5,00**
ECTS Credit			**5,00**

Course Learning Outcomes	
No	**Outcome**
L1	Define basic terms and concepts of matrices, vectors and complex numbers
L2	Apply the matrix calculus in solving a system of linear algebraic equations
L3	Analyze the solution set of a system of linear equations.
L4	Generalize the concepts of a real (complex) vector space to an arbitrary finite dimensional vector space.
L5	Investigate properties of vector spaces and subspaces using by linear transformations.
L6	Determine whether a subset of a vector space is linear dependent.
L7	Express linear transformation between vector spaces.
L8	Represent linear transformations by matrices.

Contribution of Course Learning Outcomes to Program Competencies/Outcomes

Contribution Level: 1: Very Slight, 2: Slight, 3: Moderate, 4: Significant, 5: Very Significant

	P1	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**	**P11**					**Total**
L1	X	X	X	X	X											
L2	X	X	X	X	X											
L3	X	X	X	X	X											
L4	X	X	X	X	X											
L5	X	X	X	X	X											
L6	X	X	X	X	X											
L7	X	X	X	X	X											
L8	X	X	X	X	X											
															Total	

i. Sufficient knowledge in the fields of mathematics, natural sciences, and related engineering disciplines; the ability to apply theoretical and practical knowledge in solving complex engineering problems.

ii. The ability to identify, formulate, and solve complex engineering problems; the ability to select and apply appropriate analysis and modeling methods for this purpose.

iii. The ability to design a complex system, process, device, or product to meet specific requirements under realistic constraints and conditions; the ability to apply modern design methods for this purpose.

iv. The ability to select and use modern techniques and tools required for the analysis and solution of complex problems encountered in engineering applications; the ability to effectively use information technologies.

v. The ability to design experiments, conduct experiments, collect data, analyze results, and interpret findings for the investigation of complex engineering problems or discipline-specific research topics.

vi. The ability to work effectively in intra-disciplinary and multidisciplinary teams; the ability to work independently.

vii. The ability to communicate effectively both orally and in writing; proficiency in at least one foreign language; the ability to write effective reports, understand written reports, prepare design and production reports, make effective presentations, and give and receive clear and understandable instructions.

viii. Awareness of the necessity of lifelong learning; the ability to access information, track developments in science and technology, and continuously renew oneself.

ix. Acting in accordance with ethical principles, knowledge of professional and ethical responsibilities, and the standards used in engineering applications.

x. Knowledge of business practices such as project management, risk management, and change management; awareness of entrepreneurship and innovation; knowledge of sustainable development.

xi. Knowledge of the impact of engineering practices on health, environment, and safety at global and societal levels, and awareness of contemporary engineering issues; awareness of the legal consequences of engineering solutions.