MI1036 ALGEBRA

Version: 2023.1.0

Objective: This course aims to provide students with basic knowledge of set theory, complex numbers and linear algebra.

Contents: Sets. Mappings. Complex numbers. Matrices. Determinants. Systems of linear equations. Vector spaces. Linear maps. Eigenvalues and eigenvectors. Euclidean spaces. Quadratic curves and quadric surfaces.

1. GENERAL INFORMATION

Course title: Algebra

Course ID: MI1036

Course Units: 4 (3-2-0-6)

- Lecture: 45 hours
- Exercises: 30 hours

Previous module:

Prerequisites:

Companion module: None

2. DESCRIPTION

This course aims to provide students with basic knowledge of set theory, complex numbers and linear algebra. Topics includes sets, mappings, complex numbers, matrices, determinants, systems of linear equations, vector spaces, linear maps, eigenvalues and eigenvectors, Euclidean spaces, quadratic curves and quadric surfaces.

3. OBJECTIVES AND EXPECTED OUTCOMES

Students who complete this module should have the abilities to:

Objectives	Objectives description/Expected Outcomes	Outcome standards allocated for modules/ Levels (I/T/U)
[1]	[2]	[3]
M1	**Understand and can present concepts of linear algebra which, from a modern point of view, are most important in connection with practical problems**	
M1.1	Students understand and can present of matrices and linear systems of equations, linear transformations and eigenvalue problems, as they arise, for instance, from electrical networks, frameworks in mechanics, processes in statistics, systems of differential equations and so on.	I/T
M1.2	Students are capable to think mathematically and recognize the need for applying mathematical methods to engineering problems.	T/U
M2	**Positive working attitude and skills**	

Objectives	Objectives description/Expected Outcomes	Outcome standards allocated for modules/ Levels (I/T/U)
M2.1	Ability to analyze and solve problems independently	T/U
M2.2	Ability to use algebra solving simple realistic problems through obsevation	I/T/U
M2.3	Critical thinking, collaboration and teamwork	I/T

4. COURSE MATERIALS

Textbooks

[1] Nguyen Thieu Huy, Lecture on Algebra, weblink:https://sami.hust.edu.vn/hoc-tap/wp-content/uploads/lecture_on_algebra-2.pdf.

References

[1] S. Axler (2015), *Linear Algebra Done Right*, 3rd edition. Springer.

[2] E.H. Connell (2001), *Elements of abstract and linear algebra*, http://www.math.miami.edu/_ec/book/

[3] S. Lipschutz (1991), *Schaum's Outline of Theory and Problems of Linear Algebra*, (Schaum,1991). McGraw-hill, New York.

[4] Gilbert Strang (2016), *Introduction to Linear Algebra*, 5th edition. Wellesley-Cambridge Press.

5. EVALUATION

Components	Evaluation method	Description	Rated outcome standards	Proportion
[1]	**[2]**	**[3]**	**[4]**	**[5]**
A1. Attendance mark	**A1.1.** Learning attitude	Attendance check		**20%**
A2. Process mark (*)	**A2.1.** Midterm exam 1 (KT1 points on the 15-point scale) (Contents: Chapter 1 and Chapter 2)	Multiple-choice	M1.1 M1.2 M2.1 M2.2 M2.3	**30%**
	A2.2. Midterm exam 2 (KT2 points on the 15-point scale) (Contents: Chapter 3 and Section 4.1 of Chapter 4)			
A3. Final exam mark	**A3.1. Thi cuối kì (Final exam)**	Essay	M1.1 M1.2 M2.1 M2.2 M2.3	**50%**

(*) *The process mark is one third of the sum of the two midterm exams' marks. The process mark is adjusted by adding points for the performance of students during the course. These points vary from -1 to +1 according to the Regulations of Higher Education of Hanoi University of Science and Technology.*

6. COURSE PLAN

Week	Topics	Objective	Activities	Exercises
[1]	[2]	[3]	[4]	[5]
1	**Introduction** - Lecturer - Topics related to the course - Teaching and assessment methods **Chapter 1: Sets, mappings and complex numbers** 1.1. Sets and set operations - Notations, subset - Intersection, union, complement 1.2. Mappings - Definition - Properties: injective, surjective, bijective mappings - Image, inverse images - Composition of mappings, inverse of a bijective mapping	M1.1 M1.2 M2.1 M2.3	**Lecturer:** - Self-introduction, - Introduce teaching and assessment methods, - Discussion, - Q & A **Students:** - Preparation for the next lecture - Do exercises (classroom and homework)	A1.1 A2.1 A3.1
2	1.3. Algebraic structures - Binary operations - Concepts and examples of groups, rings, fields. 1.4. Field of complex numbers - Addition, multiplication - Trigonometric form - *n*th root, exponentiation	M1.1 M1.2 M2.1 M2.2 M2.3	**Lecturer:** - Teaching, - Discussion, - Q & A **Students:** - Preparation for the next lecture - Do exercises (classroom and homework)	A1.1 A2.1 A3.1
3	**Chapter 2: Matrices, linear systems of equations** 2.1. Basic concepts of matrices - Definitions - Some types of matrices			A1.1 A2.1 A3.1
4	2.2. Matrix operations - Addition - Scalar multiplication - Matrix multiplication - Matrix transposition			A1.1 A2.1 A3.1
5	2.3. Linear systems of equations			A1.1 A2.2

Week	Topics	Objecti ve	Activities	Exercises
[1]	[2]	[3]	[4]	[5]
	- Gauss elimination - Application to electrical networks **Chapter 3: Vector spaces, rank and inverse of matrices** 3.1. Definition and examples - Vector spaces			A3.1
6	- Subspaces 3.2. Dimension and Coordinate - Linear independence - Bases - Coordinates - Dimension - Change of basis			A1.2 A2.2 A3.1
7	3.3. Rank - Rank of a vector system - Rank of a matrix			A1.2 A2.2 A3.1
8	3.4. Linear systems of equations revisited - General properties of solutions 3.5. Inverse and determinant of a matrix - Inverse of a matrix - Determinant of a matrix			A1.2 A2.2 A3.1
9	**Mid-term break**			
10	- Rank in terms of determinants, Cramer's rule **Chapter 4: Linear mappings (maps)** 4.1. Linear mappings - Definitions and examples - Matrix of a linear mapping - Kernel, range and rank of a linear mapping	M1.1 M1.2 M2.1 M2.2 M2.3	**Lecturer:** - Introduction - Teaching, - Discussion, - Q & A **Students:** - Preparation for the next lecture - Do exercises (classroom and homework)	A1.2 A2.2 A3.1
11	4.2. Isomorphic spaces 4.3. Linear operators (transformations, endomorphism) - Matrix of a linear operator - Change of basis			A1.1 A3.1
12	- Similarity **Chapter 5: Eigenvalues and eigenvectors**			A1.1 A3.1

Week	Topics	Objecti ve	Activities	Exercises
[1]	[2]	[3]	[4]	[5]
	5.1. Eigenvalues and eigenvectors - Eigenvalues and eigenvectors of a matrix - Eigenvalues and eigenvectors of linear transformations			
13	5.2. An application of eigenvalue problems - stretching of an elastic membrane 5.3. Properties of eigenvectors - Characteristic equations - Diagonalization of a matrix			A1.1 A3.1
14	**Chapter 6: Euclidean spaces, orthogonality** 6.1. Inner products - Length and orthogonality - Euclidean spaces 6.2. Orthogonality - Orthogonal sets - Orthogonal projections - Orthonormal bases - Gram-Schmidt process			A1.1 A3.1
15	6.3. Least square approximations 6.4. Orthogonal diagonalization - Orthogonal matrices - Orthogonal diagonalization of a symmetric matrix			A1.1 A3.1
16	6.5. Quadratic forms - Matrix of a quadratic form - Reduction of quadratic forms to canonical forms - Quadratic curves and quadric surfaces			A1.1 A3.1

7. RULES OF THE MODULE

8. DATE OF APPROVAL: ……..

School of Applied Mathematics and Informatics