هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

Course Specifications

Course Title:	**Linear Algebra (1)**
Course Code:	**MTH1211**
Program:	**BSc. in Mathematics**
Department:	**Mathematical science**
College:	**Applied science**
Institution:	**Umm Al-Qura University**

Table of Contents

A. Course Identification

1. Credit hours: 4
2. Course type **a.** University ☐ College ☐ Department ■ Others ☐ **b.** Required ■ Elective ☐
3. Level/year at which this course is offered: Third level/First year
4. Pre-requisites for this course (if any): Foundation of Mathematics
5. Co-requisites for this course (if any): Non

6. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	Four hours/week	% ١٠٠
2	Blended	•	•
3	E-learning	•	•
4	Distance learning	•	•
5	Other	•	•

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	Lecture	40
2	Laboratory/Studio	0
3	Tutorial	10
4	Others (specify)	0
	Total	50

B. Course Objectives and Learning Outcomes

1. Course Description

Linear Algebra is an area of mathematics that deals with the properties and applications of vectors, matrices, and other related mathematical structures. Interestingly, these topics readily lend themselves to a very rigorous study of the underlying mathematical theory, as well as to a broadly applications-oriented study of concepts, methods, and algorithms. This course will place roughly equal emphasis on theory and applications.

Main topics we will cover include linear systems and their solutions, matrix, determinants, vector space, linear transformation, eigenvalues and eigenvectors. We will study a variety of interdisciplinary applications and related strategies throughout the course.

2. Course Main Objective

The first goal of the course is to teach students how to use linear algebra as a powerful tool for computation. The second goal is to show how these computations can be conceptualized in a geometric framework. The final goal is to give a gentle introduction to the theory of abstract vector spaces.

3. Course Learning Outcomes

	CLOs	Aligned PLOs
1	**Knowledge and Understanding: by the end of this course, the student is expected to be able to**	
1.1	Identify systems of linear equations	K1
1.2	State Row reduction and echelon forms	K1
1.3	Describe the different matrix operations	K1
1.4	Memorize determinants and their properties	K1
1.5	Outline vector and sub-vector spaces and their properties	K2
1.6	Name bases and dimension of vector spaces	K2
2	**Skills: by the end of this course, the student is expected to be able to**	
2.1	Write a system of linear equations in matrix form	S1
2.2	Determine whether a system of linear equations is consistent or inconsistent	S1
2.3	Perform matrix operations and solve matrix equations	S1
2.4	Calculate an eigenvalue and an eigenvector of a given matrix	S2
2.5	Determine whether a given matrix is diagonalizable, symmetric	S2
3	**Values: by the end of this course, the student is expected to be able to**	
3.1	Analyze quantitative data verbally, graphically, symbolically and numerically	V2
3.2	Communicate quantitative data verbally, graphically, symbolically and numerically	V2
3.3	Integrate appropriately technology into mathematical processes	V2
3.4	Generalize mathematical concepts in problem-solving through integration of new material and modeling	V2

C. Course Content

No	List of Topics	Contact Hours
1	System of linear equations in a linear algebra: systems of linear equations, consistent and inconsistent systems of linear equations, Gaussian Elimination and Gauss-Jordan Elimination of linear equations.	4
2	Matrix Algebra: Matrix operations, properties of matrix operations, the inverse of a matrix (invertible matrix theorem), elementary matrices.	8
3	Determinants of square matrices: definition of determinants, evaluation of a determinant using elementary operations, properties of determinants. Applications of determinants: the inverse of a matrix by its adjoint, Cramer's rule and volume.	8

4	Vector spaces: Vectors in $\mathbb{R}^2, \mathbb{R}^3, \ldots, \mathbb{R}^n$, definition of vector space, subspaces, linearly independence, basis and dimensions, rank of a matrix, coordinate and change basis.	12
5	Inner product spaces: definition of inner product space and examples	2
6	Linear transformation: definition of linear transformation, kernel and image of linear transformation and isomorphism of vector spaces.	4
7	Eigen values and eigen vectors: Definitions and examples	2
Total		٤٠

D. Teaching and Assessment

1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
1.0	**Knowledge and Und0erstanding**		
1.1	Identify systems of linear equations	Lecture and Tutorials	Exams, quizzes
1.2	State Row reduction and echelon form	Lecture and Tutorials	Exams, quizzes
1.3	Describe the different matrix operations	Lecture and Tutorials	Exams, quizzes
1.4	Memorize determinants and their properties	Lecture and Tutorials	Exams, quizzes
1.5	Outline vector and sub-vector spaces and their properties	Lecture and Tutorials	Exams, quizzes
1.6	Name bases and dimension of vector spaces	Lecture and Tutorials	Exams, quizzes
2.0	**Skills**		
2.1	Write a system of linear equations in matrix form	Lecture/Individual or group work	Exams, quizzes, Homework
2.2	Determine whether a system of linear equations is consistent or inconsistent.	Lecture/Individual or group work	Exams, quizzes, Homework
2.3	Perform matrix operations and solve matrix equations.	Lecture/Individual or group work	Exams, quizzes, Homework
2.4	Find the determinants of a matrix in many ways.	Lecture/Individual or group work	Exams, quizzes, Homework
2.5	Calculate an eigenvalue and an eigenvector of a given matrix	Lecture/Individual or group work	Exams, quizzes, Homework
2.6	Determine whether a given matrix is Diagonalizable, symmetric or orthogonal	Lecture/Individual or group work	Exams, quizzes, Homework
3.0	**Values**		
3.1	Analyze quantitative data verbally, graphically, symbolically and numerically	Lecture/Individual or group work	Exams, quizzes, research essays
3.2	Communicate quantitative data verbally, graphically, symbolically and numerically	Lecture/Individual or group work	Exams, quizzes, research essays
3.3	Integrate appropriately technology into mathematical processes	Lecture/Individual or group work	Exams, quizzes, research essays

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
3.4	Generalize mathematical concepts in problem-solving through integration of new material and modeling	Lecture/Individual or group work	Exams, quizzes, research essays

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Midterm exam	Sixth week	%30
2	Quizzes, homework, and research essays	During semester	%٢٠
4	Final exam	End of semester	%٥٠

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

E. Student Academic Counseling and Support

Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice:

All faculty members are required to be in their offices outside teaching hours. Each member allocates at least 4 hours per week to give academic advice to students and to better explain the concepts seen during the lectures.

Students are required to complete the homework problems. Students are welcome to work together on homework. However, each student must turn in his or her own assignments, and no copying from another student's work is permitted. Deadline extensions for homework will not be given. Students are encouraged to discuss with professor about homework problems.

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	• R. Larson, B. Edwards and D. Falvo, Elementary Linear Algebra, Houghton Mifflin Harcourt, 6th edition ,2009. • T. S. Blyth and E. F. Robertson, Basic Linear Algebra, Springer, London, 1998.
Essential References Materials	• T. David, Guide to linear algebra. Macmillan International Higher Education, 1988. • G. Strang, Introduction to Linear Algebra. 5th Edition. Wellesley, MA: Wellesley-Cambridge Press, 2016.
Electronic Materials	https://en.wikipedia.org/wiki/Linear_algebra
Other Learning Materials	None

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	Large classrooms that can accommodate more than 30 students
Technology Resources (AV, data show, Smart Board, software, etc.)	Data Show, Smart Board
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	None

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching and assessment	Students	Direct
Quality of learning resources	Students	Direct
Extent of achievement of course learning outcomes	Faculty Member	Direct

Evaluation areas (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
Evaluators (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
Assessment Methods (Direct, Indirect)

H. Specification Approval Data

Council / Committee **Reference No.**	Prof. Dr. Ahmad Mohammed Alghamdi and Eman Allugmani and Amani Alkatheri
Date	