Department of Mathematics

College of Basic Education

Salahaddin University - Erbil

Subject: Linear Transformation

Course Book – 2nd Stage

Lecturer's name: Dr. Payman A.Rashed

Second Semester

Academic Year: 2023/2024

Course Book

1. Course name	**Linear Transformation**
2. Lecturer in charge	**Dr. Payman A.Rashed**
3. Department/ College	**Mathematics/ Basic Education**
4. Contact	**e-mail: payman.rashed@su.edu.krd** **Tel:**
5. Time (in hours) per week	**Theory: 3 hours per week**
6. Office hours	**Sunday 12:30- 1:30, Tuesday 8:30-10:30**
7. Course code	
8. Teacher's academic profile	• Ph. D. in Mathematics. Mathematics Department - College of Computer Sciences and Mathematics – University of Mosul in 2015. • M. Sc. in Mathematics. Mathematics Department - College of Science Salahaddin University - Erbil in 2002. • B. Sc. in Mathematics, Mathematics Department - College of Science – Mosul University - Mosul in 1988.
9. Keywords	**Linear Transformation, Matrix of Linear Transformation,…**

10. Course overview:

This course aims to introduce the basic ideas and techniques of linear algebra for use in many other lecture courses. The course will also introduce some basic ideas of abstract algebra and techniques of proof which will be useful for future courses in pure mathematics. The main aim of the course is

1. To introduce the concept of vector spaces, subspaces, linear independence, basis and transition matrices,
2. To introduce the concept of linear transformation and its connection with matrices,
3. Eigenvalues and eigenvector of linear transformations and diagonalization, and
4. To explore the concept of a real vector space with the idea of an inner product.

11. Course objective:

Students will be able to apply the concepts and methods described in the syllabus, they will be able to solve problems using linear algebra, they will know a number of applications of linear algebra, and they will be able to follow complex logical arguments and develop modest logical arguments. The text and class discussion will introduce the concepts, methods, applications, and logical arguments; students will practice them and solve problems on daily assignments, and they will be tested on quizzes, midterms, and the final.

12. Student's obligation

Please do not miss any class unless absolutely necessary. If you miss a class period, you are still responsible for learning the material covered on the day you missed, and also for any work which was assigned on the day you missed.

13. Forms of teaching:
White board and Presentation slides in Power Point, Lecture notes.

14. Assessment scheme
There will be two tests and a final exam., and Your final grade will be computed as follows:

Test 1	**20%**
Test 2	15%
Quiz and Homework	5%
Final Exam.	60%
Total	100%

16 References.

[1] Smith L.(1978), Linear Algebra , 3rd edition
2-Lang S.(), Linear Algebra
3- Krishnamurthy V.(), An introduction to Linear Algebra ,
4-Kolman B., Elementary Linear Algebra
5- السبتي ضايف جورج الجبرالخطي

17 Syllabus of Mathematical Analysis.

Subject	Weeks
Chapter One: Review of Some Concepts in Linear Algebra	1
Linear transformations, sum and scalar multiplication of linear transformations	2
	3
Kernel and image of Linear transformations, rank and nullity of Linear transformations.	4
	5
Composition of linear transformations, inverse of linear transformations and isomorphic spaces.	6,7
Chapter Two: Matrix of linear transformations and normal form.	8,9
Eigenvalues and eigenvectors of linear transformation	10
characteristic polynomial and characteristic equations	11
Eigen spaces, geometric and algebraic multiplicities. Diagonalizability for linear transformations.	12,13

19. Examinations:

Sample of Examination:

Q1/ Prove or disprove the following

i) Im(T) is a subspace of W, where T:V→ W is a linear transformation

ii) Let $T: V \to W$, be a linear transformation, then $Kert \subseteq KerT^2$.

Q2/ Let $T: R^2 \to R^3$ be a function defined by $T(a,b) = (a+b, a-b, 2a)$, then

1) Show that T is a linear transformation

2) Find Ker (T) and Im(T)

3) Is T has a left or right inverse? Explain it

Q3/ Find a linear transformation $T: R^2 \to M_2(R)$, such that a matrix of T with respect to a basis $\{(-1,1),(0,3)\}$ of R^2 and $\{\begin{pmatrix} 2 & 0 \\ 0 & 0 \end{pmatrix}, \begin{pmatrix} 0 & 3 \\ 0 & 0 \end{pmatrix}, \begin{pmatrix} 0 & 0 \\ -1 & 0 \end{pmatrix}, \begin{pmatrix} 0 & 0 \\ 0 & 4 \end{pmatrix}\}$ of $M_2(R)$ is

$$M = \begin{pmatrix} 1 & 1 & -1 & 0 \\ 3 & 0 & 0 & 2 \end{pmatrix}$$

Q4/ Show that a linear transformation $T: P_1(R) \to P_1(R)$ is diagonalizable, if $T^2 = T$.

20. Extra notes:

21. Peer review