T-104

Course Specification

Course Title:	**Linear Algebra**
Course Code:	MATH 2301-3
Program:	Bachelor in Engineering
Department:	Engineering
College:	College of Engineering
Institution:	King Khalid University
Version:	2
Last Revision Date:	25/03/2023

Table of Contents:

A. General information about the course:

Course Identification					
1. Credit hours:	4				
2. Course type					
a.	University ☐	College ☐	Department☒	Track☐	Others☐
b.	Required ☒	Elective☐			
3. Level/year at which this course is offered:	6th level / 3rd year				

4. Course general Description

Course Description

This course discusses the vectors in Rn, vector addition and scalar multiplication, dot (Inner) Product, located vectors in R3 (Spatial Vectors), and complex vectors in Cn. Secondly, the course covers the followings:

- **Algebra of Matrices**
  Introduction of Matrices, Matrix Addition and Scalar Multiplications, Summation Symbol, Matrix Multiplications, Transpose of a Matrix, Square Matrices, Powers of Matrices, Polynomials in Matrices, Invertible (Nonsingular) Matrices, Special Types of Square Matrices.
- **Systems of Linear Equations**
  Introduction and basic definitions, Solutions of equivalent systems, Elementary Operations, Small Square Systems of Linear Equations, Systems in Triangular and Echelon Forms, Gaussian Elimination, Echelon Matrices, Row Canonical Form, Row Equivalence, Gaussian Elimination, Matrix Formulation, Matrix Equation of a System of Linear Equations, Systems of Linear Equations and Linear Combinations of Vectors, Homogeneous Systems of Linear Equations.
- **Vector Spaces**
  Introduction of Vector Spaces, Examples of Vector Spaces, Linear Combinations, Spanning Sets, Subspaces, Linear Spans, Row Space of a Matrix, Linear Dependence and Independence, Basis and Dimension, Application to Matrices, Rank of a Matrix, Sums and Direct Sums, Coordinates.
- **Linear Mappings**
  Introduction of Mappings, Functions, Linear Mappings (Linear Transformations), Kernel and Image of a Linear Mapping, Singular and Nonsingular Linear Mappings, Isomorphisms, Operations with Linear Mappings.

5. Pre-requirements for this course (if any):

None

6. Co- requirements for this course (if any):

None

7. Course Main Objective(s)

On successful completion of this course, students should be able to:

This course will introduce students to:

Linear algebra has in recent years become an essential part of the mathematical background required by mathematicians and mathematics teachers, engineers, computer scientists, physicists, economists, and statisticians, among others. This requirement reflects the importance and wide applications of the subject matter. The first three chapters treat vectors in Euclidean space, matrix algebra, and systems off linear equations. These chapters provide thee motivation and basic computational tools for the abstract investigations off vector spaces and linear mappings which follow. After chapters on inner product spaces and orthogonality and on

determinants, there is a detailed discussion of eigenvalues and eigenvectors giving conditions for representing a linear operator by a diagonal matrix. This naturally leads to the study of various canonical forms, specifically, the triangular, Jordan, and rational canonical forms.

1. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1.	Traditional classroom	--	--
2.	E-learning	--	--
3.	Hybrid ● Traditional classroom ● E-learning	4	100
4.	Distance learning	--	--

2. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	Lectures	48
2.	Laboratory/Studio	--
3.	Field	--
4.	Tutorial	??
5.	Others (specify)	--
	Total	48

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	Knowledge and understanding			
1.1	Understand and apply matrix and vector algebra, and relate matrices to linear transformations. Understand and Apply fundamental concepts of vector spaces such as span, linear independence, basis, and dimension	K1	Lectures, up-to-date textbooks, hand-outs, develop skills in using library and other learning resources, use of the Internet.	Exams, tutorials, supervision, presentations, essays, feedback on written work and homework.
1.2				
…				
2.0	Skills			
2.1	Apply matrix and vector algebra, and relate matrices to linear transformations. Solve systems of linear equations using Gauss elimination methods	S1	Tutorials, Group working, problem-solving,	Exams, tutorials, supervision, presentations, feedback on

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
2.2	Calculate the determinant of square matrices. Perform basic matrix operations.	S2	discussion, feedback on written work, exam papers, critical assessment, peer assessment, self-assessment.	written work and homework, exam papers, critical assessment, peer assessment, self-assessment.
2.3	Determine whether the matrix is positive definite, negative definite or indefinite by finding Eigen values.	S3		
2.4	Apply fundamental concepts of vector spaces such as span, linear independence, basis, and dimension	S4		
3.0	Values, autonomy, and responsibility			
3.1	Adhere to ethical values and excellence in professional practices.	V1	Feedback, experiential learning, structured experiences in groups, self-assessment, profiling.	Critical assessment, self-assessment, Rubrics
3.2	Able to articulate awareness of and demonstrate personal characteristics and critical thinking that positively impact the learning process.	V2		
3.3	Take full responsibility for initiating, identifying, amending, and achieving aims.	V3		

C. Course Content

No	List of Topics	Contact Hours
1.	Spatial Vectors	6
2.	Algebra of Matrices	10
3.	Systems of Linear Euqations	10
4.	Vector Spaces	10
5.	Linear Mappings	6
6.	Diagonalization: Eigenvalues and Eigenvectors	6
Total		48

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Practical applications (solutions exercises), quizzes, and homework	Weekly	35
2.	Partial exam (Mid term exam)	7	25
3.	Final exam	13	40

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.)

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	**Elementary Linear Algebra, by Howard Anton and Chris Rorres 11th Edition**
Supportive References	**Linear Algebra, Schaum's outlines 4th Edition**
Electronic Materials	● Websites on the internet that are relevant to the topics of the course. ● E-learning lms.kku.edu.sa
Other Learning Materials	None

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Lecture room for 25 students, Classrooms Whiteboards, Tables and Chairs.
Technology equipment (Projector, smart board, software)	● Data show device, Video Conference system and Smart boards ● Computers loaded with modern software and connected to Internet service
Other equipment (Depending on the nature of the specialty)	Not Applicable

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Peer Reviewer + Students	Direct
Effectiveness of students' assessment	Peer Reviewer + Q&D Committee	Direct
Quality of learning resources	Programs & Curricula Committee + Q&D Committee	Direct
The extent to which CLOs have been achieved	Quality and Development Committee	Indirect
Other		

Assessor (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval Data

COUNCIL /COMMITTEE	
REFERENCE NO.	
DATE	**25-3-2023**