Course Specification
(Bachelor)

Course Title:	**Introduction to Linear Algebra**
Course Code:	**MAT 1221**
Program:	**Bachelor of Science in Physics**
Department:	**Mathematics and Statistics**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**
Version:	**2024 – V1**
Last Revision Date:	**08/10/2024**

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours:					
3 (2 Lectures, 0 Lab, 2 Tutorial)					
2. Course type					
A.	☐University	☐ College	☒ Program	☐Track	☐Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: Level 4 / Year 2					
4. Course general Description:					
This course describes the most important ideas, theoretical results, and examples of matrices, vector spaces, linear transformations, eigenvalues and eigenvectors. The course includes the essential fundamentals of these topics. The emphasis is on calculations.					
5. Pre-requirements for this course (if any)**:**					
None.					
6. Co-requisites for this course (if any)**:**					
None.					
7. Course Main Objective(s):					
To provide students with a good understanding about matrices concept and methods of linear algebra To let students be familiar with basics of vector spaces and linear transformations. To connect linear algebra to other fields.					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	60	100%
2	E-learning	0	0%
3	Hybrid • Traditional classroom • E-learning	0	0%
4	Distance learning	0	0%

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	30
2.	**Laboratory/Studio**	0
3.	**Field**	0
4.	**Tutorial**	30
5.	**Others (specify)**	0
Total		60

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	Explain the processes of Gauss elimination, matrix operations, and the concept of matrix inverses.	K2	Lecture and guided problem-solving sessions	Quizzes and written assignments
1.2	Summarize the properties of determinants and their applications, including Cramer's Rule and evaluating determinants.	K2	Interactive workshops and group discussions	Homework assignments and in-class exercises
1.3	Identify key concepts of vector spaces, including linear dependence, basis, and dimension.	K1	Lecture discussions and visual demonstrations	Exams and problem sets
1.4	Describe the fundamentals of eigenvalues and eigenvectors, including diagonalization and their applications.	K2	Project-based learning and collaborative work	Projects and presentations
2.0	**Skills**			
2.1	Find inverse of a square matrix by using its determinant and extension matrix to solve some world-real problems.	S1, S2	Self-study Real-life problems	Participations Short Quizzes
2.2	State, clearly and precisely both orally and in writing, the general solution of at most a 4×4 linear system using appropriate method of linear algebra matrix including Gaussian elimination and matrix inversion.	S4	Regular Exams	Participations
2.3	Use CAS and online solver to manipulate matrices.	S5	Assignments	Short Quizzes

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
2.4	Compute eigenvalues and eigenvectors of square matrix to produce the diagonalization of the matrix.	S3	Short Quizzes	Participations
3.0	**Values, autonomy, and responsibility**			
3.1	Work individually and in group	V1, V3	Class activities	Individual and group coursework
3.2	Show attitude of support the use of computers in Matrix manipulation.	V1, V2	Class discussion	participation

C. Course Content

No	List of Topics	Contact Hours
1.	**Matrices and Gauss Elimination:** Linear Systems and Matrices (Gauss Eliminations, Echelon & Reduced Echelon Forms, Matrix Operations, Matrix Inverses), Determinants (Minor & Cofactors, Evaluating Determinants, Cramer's Rule, Adjoints & Matrix Inverses).	**20**
2.	**Vector Spaces:** Spaces Vector Spaces and Subspaces, Euclidean Vector Spaces ℝ², Linear Dependence & Independence, Basis and Dimensions of Vector Space, Change of a Basis.	**15**
3.	**Linear Transformations:** Definition and Basics, The Kernel and the Image, Linear Transformation Matrix, Nonsingular Transformations and their Inverses.	**10**
4.	**Eigenvalues and Eigenvectors:** Characteristic Polynomial, Eigenvalues, Eigenvectors, Diagonalization, Triangulation, Matrix Powers. Inner Product Space, Angle and Orthogonality in Inner Product Spaces, Gram–Schmidt Process.	**15**
Total		**60**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	HomeWorks, Quizzes, Mini-projects	During the term	10%

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
2.	First Midterm	Week 5-6	25%
3.	Second Midterm	Week 10-11	25%
4.	Final Exam	Week 15-16	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;* **11th Edition; H. Anton, C. Rorres, Wiley, 2014. (Main Reference)**
Supportive References	*Linear Algebra with Application,* **5th Edition; W. K. Nicholson, McGraw- Hill, 2006.** *Linear Algebra with Application,* **4th Edition; O. Bretscher; Pearson Ed. Int., 2009.** *Linear Algebra, Schaum's Outline,* **S. Lipschutz, M. Lipson, McGraw-Hill 3rd Edition, 2000**
Electronic Materials	
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	• **Classrooms:** Equipped with whiteboards, projectors, and Smart Boards for interactive lessons and group discussions. • **Laboratories:** Feature computers with internet access, enabling hands-on activities and exploration of algebraic and trigonometric concepts. • **Exhibition Rooms:** Spaces for showcasing projects and presentations to encourage collaborative learning.
Technology equipment (projector, smart board, software)	• **Data Show Projectors:** For clear presentations in classrooms and labs. • **Smart Boards:** To enhance interactivity during lessons. • **Mathematical Software:** Essential for graphing and analysis.
Other equipment (depending on the nature of the specialty)	• **Computers:** For mini-project and homework and practical applications in laboratories. • **Advanced Calculators:** For computations and problem-solving and supporting matrix computation. • **Whiteboards and Markers:** To facilitate brainstorming and collaboration.

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Student and teaching staff	Surveys and Questionnaires

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of Students assessment	Course Coordinator	Peer Reviews
Quality of learning resources	Students and teaching staff	Classroom Observations
The extent to which CLOs have been achieved	Student Representatives	Student Performance Evaluations (exams, projects) CLOs Excel sheet.
Other	**None**	

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

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	**MATHEMATICS AND STATISTICS DEPARTMENT COUNCIL**
REFERENCE NO.	**8/1446**
DATE	**05/04/1446 (08/10/2024)**