Course Specification

(Bachelor)

Course Title:	**Linear Algebra and Differential Equations**
Course Code:	**MAT 1224**
Program:	**Bachelor of Science in Actuarial and Financial Mathematics**
Department:	**Mathematics and Statistics**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**
Version:	**2024 – V 1**
Last Revision Date:	**None**

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 3 / Year 2					
4. Course general Description:					
This course covers matrix theory and linear algebra, emphasizing topics useful in other disciplines. Linear algebra is a branch of mathematics that studies systems of linear equations and the properties of matrices. The concepts of linear algebra are extremely useful in physics, economics and social sciences, natural sciences, and engineering. Due to its broad range of applications, linear algebra is one of the most widely taught subjects in college-level mathematics (and increasingly in high school). **The laws of nature are expressed as differential equations. Scientists and engineers must know how to model the world in terms of differential equations, and how to solve those equations and interpret the solutions. This course focuses on linear differential equations and their applications in science and engineering.**					
5. Pre-requirements for this course (if any)**:**					
MAT 1105					
6. Co-requisites for this course (if any)**:**					
None					
7. Course Main Objective(s):					
After successfully completing the course, students will have a good understanding of the following topics and their applications: • Systems of linear equations; • Matrix operations, including inverses, and Block matrices; • Vector spaces; • Gram-Schmidt process; • Linear models and least-squares problems • Eigenvalues, eigenvectors, Diagonalization, and Triangulation of a matrix; • First order differential equations; • Second order differential equations.					

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	**Define basics of matrix theory.**	**K1, K3**	**3 lecture hours\week**	**Direct: Regular Exams**
1.2	**Recall vector spaces and linear transformations**	**K1**	• **2 tutorial hours\week** • **Self-study**	**Direct: Short Quizzes**
1.3	**Describe techniques for solving first order differential equations, second order differential equations with constant coefficients**	**K3**	**3 lecture hours\week**	**Direct: Regular Exams**
2.0	**Skills**			
2.1	**Compute inverses of matrices**	**S3**	• **Self-study** • **Real-life problems**	**Direct:** • **Participations** • **Short Quizzes**
2.2	**Apply orthonormalization to bases**	**S3**	**Self-study**	**Direct: Participations**
2.3	**Implement different types of first order differential equations**	**S3**	**Real-life problems**	**Direct: Short Quizzes**
2.4	**Outline linear second order differential equations**	**S3**	**Self-study**	**Direct: Participations**
3.0	**Values**			
3.1	**Generate initiatives with independence.**	**V1, V2**	**Personal questions**	**Direct: Participation**
3.2	**Develop personal values and attributes such as honesty, empathy and respect for others.**	**V1, V2**	**Teamwork and class discussions.**	**Direct: Homework and Mini projects**

C. Course Content

No	List of Topics	Contact Hours
1.	**Matrices and Gauss Elimination:** Solving linear systems, matrix notation, augmented matrix of a linear system, row and row reduced echelon form a matrix, Gaussian and Gauss-Jordan Elimination. Algebra of matrices, Inverse of a square matrix, Transpose of a matrix. Determinants and their properties. Determinant by cofactor expansions. Cramer's Rule.	12
2.	**Vector Spaces:** Vectors in R2 and R3. Dot product, norm, angle and distance, orthogonal vectors. General vector spaces and subspaces. Linear combinations. Linear dependence and independence. Spanning sets, Basis and dimension of a vector space.	12
3.	**Eigenvalues and eigenvectors:** Eigenvalues and eigenvectors of a square matrix, characteristic polynomial of a square matrix, and basis of eigenvector subspace, Diagonalization, Triangulation, and Matrix power.	12
4	**First order differential equations:** First order differential equations. Separable equations, Integrating factor. Substitution methods, exact equations, Bernoulli equations, homogeneous differential equations	12
5	**Second order linear differential equations with constant coefficients:** general solution of homogeneous second order linear differential equation, particular solution of non-homogeneous equation, The undetermined coefficients and variation of constants methods.	12
	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%
2.	First Midterm	Week 5-6	25%
3.	Second Midterm	Week 10-11	25%
4.	Final Exam	Week 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	• Gareth Williams, Linear Algebra with Applications, (Jones & Bartlett Learning, LLC), 8th Edition, 2014 (for the first part, Chapters 1-4)

	• Denis G. Zill, A First Course in Differential Equations with Modeling Applications, 10th Edition, Brooks/Cole, Cengage Learning, 2013 (for the second part, Chapters 5-6)
Supportive References	1. Elementary Linear Algebra; 11th edition; H.Anton, C. Rorres, Wiley, 2014. 2. Linear Algebra with Application; 5th Edition; W.K. Nicholson, McGraw-Hill, 2006. 3. Fundamentals of Differential Equations; 9th Edition, R. Kent Nagle, Edward B. Saff, Arthur David Snider, Pearson, 2017.
Electronic Materials	None
Other Learning Materials	None

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	▪ Each class room should be equipped with a whiteboard and a projector. ▪ Laboratories should be equipped with computers and an internet connection.
Technology equipment (projector, smart board, software)	The rooms should be equipped with data show and Smart Board.
Other equipment (depending on the nature of the specialty)	None

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	During the semester and at the end of the course each student will complete two evaluation forms.
Effectiveness of Students assessment	Instructor	At the end of each semester the course instructor should complete the course report, including a summary of student questionnaire responses appraising progress and identifying changes that need to be made if necessary.
Quality of learning resources	Students	During the semester and at the end of the course each student will complete two evaluation forms.
The extent to which CLOs have been achieved	Instructor	At the end of each semester the course instructor should complete the course report, including a summary of student questionnaire responses appraising progress and identifying changes that need to be made if necessary.
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)**