هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

T-104
2022

Course Specification

Course Title:	Mathematical Physics I
Course Code:	PHYS 201
Program:	B.Sc. in Physics
Department:	Department of Physics and astronomy
College:	College of Science
Institution:	King Saud University
Version:	2.0.0
Last Revision Date:	Sep 2023

Table of Contents:

A. General information about the course:

Course Identification					
1. Credit hours:	**3(2+2+0)**				
2. Course type					
a.	University ☐	College ☐	Department☒	Track☐	Others☐
b.	Required ☒	Elective☐			
3. Level/year at which this course is offered:	fourth level / second year.				

4. Course general Description

The course aims to introduce students to the fundamental concepts of Linear Algebra (with related techniques for basic calculations), namely: Solving systems of linear equations; Operations on Matrices; determinants and their applications; Vector spaces (properties and calculations + inner product + basis and dimensions); Eigenpair problem (eigenvalues and eigenvectors); Diagonalizations. Some applications of linear algebra in physics are introduced during the course (exp: basic problems in EM; Coordinates transformation in classical mechanics; Angular momentum, Moment of inertia; The use of Eigenpair problem in quantum mechanics.)

5. Pre-requirements for this course (if any): Math 111

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

7. Course Main Objective(s)

1. Systems of linear equations: EROs, R.E.F & R.R.E.F, Gaussian elimination method, Homogeneous systems.
2. Matrix properties and operations. Elementary matrices
3. Determinants: properties and calculations methods, Applications (Inverse + Adjoints + Cramer's Method).
4. Vector spaces and subspaces. Spanning sets and linear dependance and independence. Basis and dimensions.
5. Euclidean n-spaces. Inner product spaces. Introduction to cross-product.
6. Eigenpair problem (values and vectors). Eigenspaces and dimensions. Diagonalization.
7. Applications of linear algebra techniques in some physics-related problems.

1. 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

2. 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	To outline the main mathematical methods/tools of the basic Linear Algebra	K1	• Give extensive examples during lecture. • Give problem sheets to be discussed during lecture.	• Hold Class discussion, tutorial sessions. • Give quizzes, mid-term exam and final exam.
1.2	To recognize the possibility of using these methods in some physical problems/aspects	K2		
2.0	Skills			
2.1	Gain skills in applying various mathematical methods of the basic Linear Algebra	S1	• Give extensive examples during lecture • Give problem sheets to be discussed during lecture and labs. • assignments. • Discussions in the classes	• Hold Class discussion, tutorial and lab sessions. • Give quizzes, mid-term exam and final exam.
2.2	Master the basic mathematical tools of Linear Algebra; Critical and logical thinking	S2		
3.0	Values, autonomy, and responsibility			
3.1	Perform mathematical/linear algebra computations in team work and independently	V1	• assignments. • Homework	Hold Class discussion

C. Course Content

No	List of Topics	Contact Hours
1.	**Systems of Linear Equations:** Linear Eqs and Systems of Linear Eqs; Augmented Matrices; Elementary Row Operations; Homogeneous Systems; R.E.F and R.R.E.F; Gaussian Elimination and Gauss-Jordan Elimination Methods for solving systems of linear Eqs.	**5**
2.	**Matrices:** Matrix properties and Operations; Transpose and its properties; The Inverse of a Matrix; Elementary Matrices and elementary row operations.	**4**
3.	**Determinants:** Determinant using Expansion by Cofactors; Determinant using Elementary Operations; Properties of Determinants; Determinant of an inverse matrix; Singular and non-singular Matrices; Applications to Determinant: Adjoint + Inverse + Cramer's Method.	**5**
4.	**Vector Spaces:** properties; Subspaces of Vector Spaces; Spanning Sets; Linear dependance and independence; Basis and Dimensions.	**5**
5.	**Euclidean n-space & Inner product spaces:** Euclidean n-space R^n: Length of a vector + Dot Product + Distances + Angles + Norms. Triangle inequality; Pythagorean theorem; Cauchy - Schwarz inequality. Inner product spaces: Inner Product and its properties. Length of a vector + Distances + Angles + Norms + Orthogonality; Generalization of Triangle inequality; Pythagorean theorem; Cauchy - Schwarz inequality; Projections; Introduction to Cross Product; Scalar Triple product and its interpretation.	**5**
6.	**Eigenpairs problem & Diagonalization:** Eigenvalues and Eigenvectors; Eigenspaces and their dimensions; Diagonalization (conditions, properties and applications).	**4**
7	**Applications in Physics:** Possible applications of linear algebra techniques in approaching some physics-related problems such as: basic problems in EM; Coordinates transformation in classical mechanics; Angular momentum, Moment of inertia; The use of Eigenpair problem in quantum mechanics.	**2**
Total Note: only for Lectures (similar hours are allocated to Tuturial sessions)		30

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	First Midterm examination	Approx. 6	20%
2.	Second Midterm examination	Approx. 12	20%
3.	Homework & Quizzes	2 to 3 per semester	20%

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
4.	Final examination	From 16 to 18	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	Textbook: ***"Elementary Linear Algebra with Supplemental Applications"***, 11th edition, by: Howard Anton and Chris Rorres; , Wiley.
Supportive References	- Mathematical Methods for Physicists By George Arfken Hans Weber Frank E. Harris, Seventh Edition, 2012, Academic Press. - Mathematical Methods for Physics and Engineering By by K. F. Riley, M. P. Hobson, S. J. Bence, Third Edition, 2006, Cambridge Press
Electronic Materials	None
Other Learning Materials	Internet sites relevant to the course Such as the online calculator websites (exp: https://www.symbolab.com/solver/vector-calculator)

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	A classroom which accommodates 25 students.
Technology equipment (projector, smart board, software)	Whiteboard and Smart board
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	Students\ Peer Reviewer	Indirect \ direct
Effectiveness of students assessment	Students- Faculty	Direct
Quality of learning resources	Students	Indirect
The extent to which CLOs have been achieved	Faculty	Indirect

Assessment Areas/Issues	Assessor	Assessment Methods
Other	None	None

Assessor (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
Assessment Methods (Direct, Indirect)

G. Specification Approval Data

COUNCIL /COMMITTEE	Physics Department's council
REFERENCE NO.	6th (1st term/1445)
DATE	28/04/1445