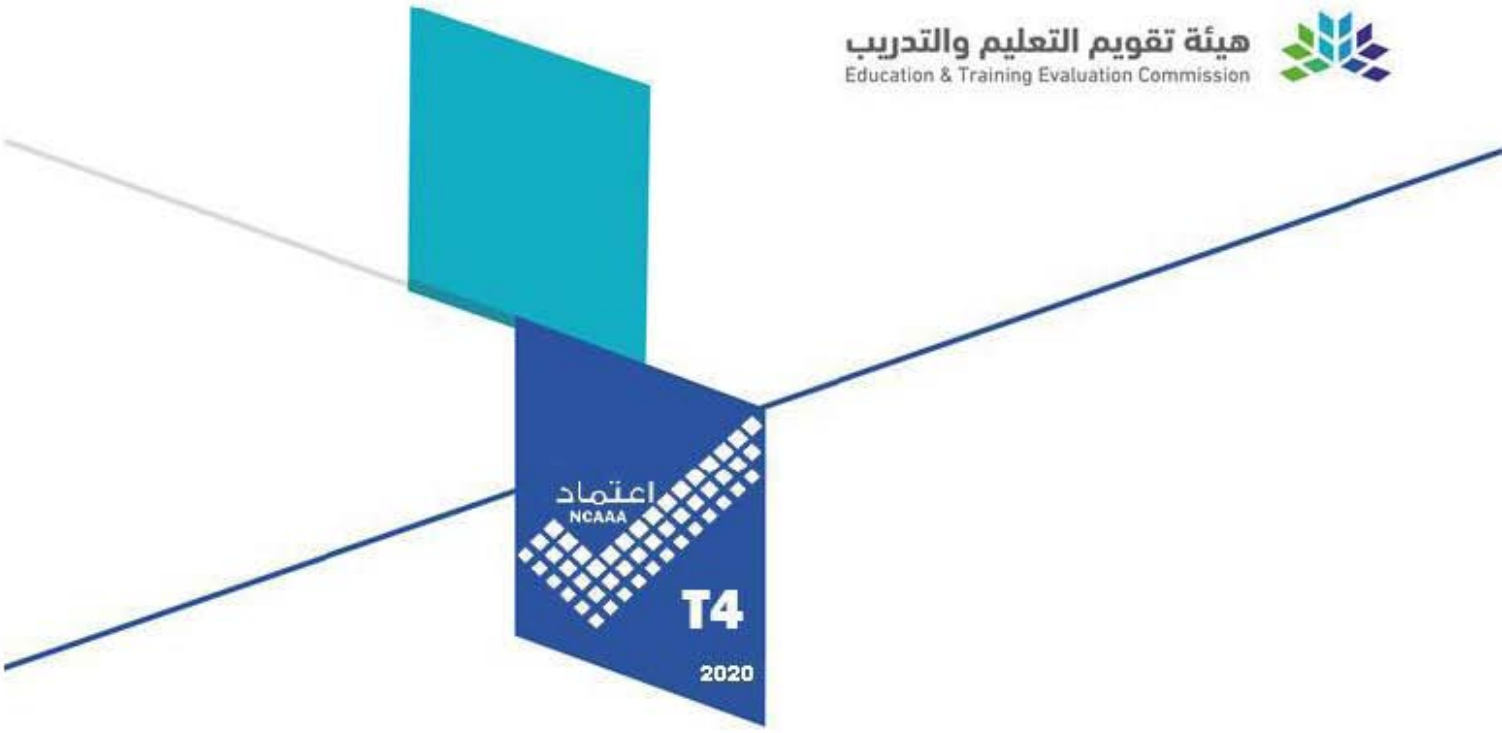
هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission



Course Specifications

Course Title:	Theoretical Methods in Physics (1)
Course Code:	**PHY1201**
Program:	**Physics**
Department:	**Physics**
College:	**Applied Sciences**
Institution:	**Umm Al-Qura University**

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A. Course Identification

1. Credit hours:	**4 hrs**
2. Course type	
a.	University ☐ College ☐ Department ☑ Others ☐
b.	Required ☑ Elective ☐
3. Level/year at which this course is offered:	**3Level /1st year**
4. Pre-requisites for this course (if any):	**General Physics (2)**
5. Co-requisites for this course (if any):	

6. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	**Traditional classroom**	40	100%
2	**Blended**		
3	**E-learning**		
4	**Distance learning**		
5	**Other**		

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	**Lecture**	40
2	**Laboratory/Studio**	-
3	**Tutorial**	-
4	**Others** (specify) Exams/ Quizzes	-
	Total	40

B. Course Objectives and Learning Outcomes

1. Course Description

The course provides a direct preparation for an advanced study in theoretical physics and is also, an interesting element in the education of an experimental physicist. The physical principles behind the mathematical models are stressed so that insight and problem solving ability becomes primary. This course will cover the basic mathematical tools used in physical science: Power Series, Linear Algebra, Partial Differentiation, Vector Analysis. All topics in these series of courses are designed and presented in a way suitable for physics students specifically. Such courses rely fundamentally on applying all the mentioned mathematical tools in solving some complicated physics problems.

2. Course Main Objective

The course is designed to supply students for a variety of mathematical methods that are needed for advanced undergraduate and beginning graduate study in physical science and to develop a solid background for those who will continue into the mathematics of advanced theoretical physics.

3. Course Learning Outcomes

	CLOs	Aligned PLOs
1	**Knowledge and Understanding**	
1.1	Recognize the meaning of infinite series & its convergence.	K1(I)
1.2		K1(I)
1.3	Recognize the properties of various types of infinite series such as; Geometric Series, Alternating Series and Power Series.	K1(I), K2(I)
1.4		K1(I), K2(I)
1.5	Express some of the algebra operations between linear transformations	K1(I), K2(I)
	Explain matrix representation of a linear transformation.	
	Find concepts of eigenvalues and eigenvectors of a matrix.	
1.6	Evaluate partial derivatives, including higher order derivatives and simple cases of the chain rule, and recognize the various notations used for partial derivatives.	K1(I), K2(I)
1.7	Define vector fields (gradient, divergence, Curl)	K1(I)
	Express and prove Green's, Stokes's, and Divergence Theorems	
2	**Skills :**	
2.1	Apply mathematical operations on series, matrices and determinants to solve physics problems.	S1(I)
2.2		S1(I)
2.3	Demonstrate the rules of partial derivatives of a given function.	S1(I)
2.4		S1(I), S2(I)
2.5	Construct the gradient vector for multivariable functions	S1(I), S2(I)
	Explain geometrical and physical concepts of the directional derivatives,gradient, divergence, and Curl.	
2.6	Apply Green's, Divergence and Stokes' Theorems to simplify some complicated integrals in physics problems.	S2(I)
3	**Values:**	
3.1	Participate effectively in multidisciplinary and/or interdisciplinary teams.	V2(I)
3.2		V1(I), V2(I)
3.3		V1(I)
3.4		V1(I)

C. Course Content

No	List of Topics	Contact Hours
1	**Infinite series, Power series:** The Geometric Series, Convergent and Divergent Series, Testing Series for Convergence, Alternating Series, Conditionally Convergent Series, Useful Facts About Series, Power Series & Interval of Convergence, Theorems About Power Series, Expanding Functions in Power Series, Techniques for Obtaining Power Series Expansions, Accuracy of Series Approximations.	8
2	**Linear Algebra:**	8

	Matrices & Determinants, Cramer's Rule, Vectors, Lines and Planes, Matrix Operations, Linear Combinations, Linear Functions, Linear Operators, Special Matrices and Formulas, Linear Vector Spaces, Diagonalizing Matrices, Eigenvalues and Eigenvectors, Applications of Diagonalization.	
3	**Partial Differentiation:** Total differentials- Approximating using differentials, chain rule Implicit differentiation, Application to Maximum and Minimum problems, Lagrange Multipliers, Change of Variables, Differentiation of Integrals.	12
4	**Vector Analysis:** Triple (Scalar-Vector) products, Differentiation of Vectors, Scalar & vector Fields, Directional Derivative & Vector operators (Del, Gradient, Divergence, Curl, and Laplace's operators), Line Integrals, Multiple integration (surface and volume integrals), Green's Theorem in the Plane, The Divergence and the Divergence Theorem, The Curl and Stokes' Theorem.	12
	Total	**40**

D. Teaching and Assessment

1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
1.0	**Knowledge and Understanding**		
1.1	Recognize what is meant by infinite series & its convergence.	1. Lectures. 2. Discussions 3. Slides and computer simulation software may be used by the teachers to clarify concepts. 4. Problems solving 5. Students may be asked to solve some problems on computer using	1- Homework assignments. 2- Group Project assignment. 3- Question – answer session in class. 4- Exams: quizzes, Mid-term, and final exams
1.2	Knowing convergence/divergence of some basis series.		
1.3	Identify various types of infinite series such as; Geometric Series, Alternating Series and Power Series.		
1.4	Expanding a given function in a power series and determine its interval of convergence.		
1.5	Identify the different types of matrices and differentiate between them and their determinants.		
1.6	Evaluate partial derivatives, including higher order derivatives and simple cases of the chain rule, and recognize the various notations used for partial derivatives.		
1.7	Be familiar with vector operators such as Del, Gradient, Divergence, Curl, etc.		
2.0	**Skills**		
2.1	Apply the appropriate test to determine whether a given infinite series is convergent or divergent.	1. Lectures. 2. Discussions. 3. Problems solving.	**1**- Homework assignments. **2**- Group Project assignment.
2.2	Be able to Diagonalize a given matrix and calculate their eigenvalues and eigenvectors.		

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
2.3	Apply partial derivatives to find the maximum and minimum of a given function.	4. Encourage the student to look for the information in different references. 5. Ask the student to attend lectures for practice solving problem. 6. Define duties for each chapter	**3**- Question – answer session in class. **4**- Exams: quizzes, Midterm, and final exams.
2.4	Calculate dot products and cross products and interpret them geometrically.		
2.5	Construct the gradient vector for multivariable functions and determine the derivative in a given direction.		
2.6	Apply Green's, Divergence and Stokes' Theorems to simplify some complicated integrals.		
3.0	**Values**		
3.1	Participate effectively in multidisciplinary and/or interdisciplinary teams	**1.** Groupe assignments **2.** Clarify deadlines for delivery of assignments, reports, and exams	**1.** Evaluate the efforts of each student in preparing the report. **2.** Evaluate the work in teams. Evaluation of students' presentations.
3.2	Accepting different ideas and respecting other opinions.		
3.3	Manage a project (modelling or simulation) with due attention to time and resource management		
3.4	Take responsibility and take the course instructions seriously.		

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Exercises and HomeWorks	All weeks	10%
2	Participation in activities and quizzes.	All weeks	10%
3	Midterm exam	6th week	30%
4	Final exam	End of the term	50%

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

E. Student Academic Counseling and Support

Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice:

4 Hours per week during office hours, in the instructor's office or by appointment.

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	Mary L. Boas, Mathematical methods in the Physical sciences, Third edition, John Wiley and Sons (2006). ISBN-13: 978-0471198260

Essential References Materials	**1.** Mathematical Methods for Physicists: A Comprehensive Guide 7th edition, by George B. Arfken, Hans J. Weber, Frank E. Harris, Academic Press is an imprint of Elsevier (2013), ISBN-13: 978-0-12-384654-9. **2.** Mathematical Methods for Physics and Engineering, by K. F. Riley, M. P. Hobson, and S. J. Bence, Cambridge University Press; (2006), ISBN-13: 978-0521679718.
Electronic Materials	
Other Learning Materials	

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	Lecture room Labs
Technology Resources (AV, data show, Smart Board, software, etc.)	data show
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	None

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Student Feedback on Effectiveness of Teaching	Students	Direct
Evaluation of Teaching	Department	Indirect
Improvement of Teaching	Program leaders	Direct
Quality of learning resources	Faculty	Direct
Extent of achievement of course learning outcomes	Program leaders	Direct

Evaluation areas (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
Evaluators (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
Assessment Methods (Direct, Indirect)

H. Specification Approval Data

Council / Committee	Dr Atif Ismail, Dr. Walid Belhadj and Prof. Khaled Abdel-Waged
Reference No.	
Date	