هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

T-104
2022

Course Specification

Course Title:	Mathematical Physics 3
Course Code:	PHYS 404
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(3+0+0)				
2. Course type					
a.	University ☐	College ☐	Department☒	Track☐	Others☐
b.	Required ☒	Elective☐			
3. Level/year at which this course is offered:	seventh level/ fourth year				

4. Course general Description

Gamma and beta functions, Legendre special functions and their application in physics. Associated Legendre functions and applications in magnetostatics and nuclear physics. Spherical harmonics and applications in quantum mechanics. Bessel functions of all types and their applications in the wave mechanics, electrodynamics and quantum mechanics. Laguerre and Associated Laguerre functions and applications in quantum mechanics. Hermite functions and their applications in solving the quantum harmonic oscillator. Fourier integral transformations and their applications in physics. Laplace transformations, and their application in the physics of waves, heat transfer and quantum mechanics.

5. Pre-requirements for this course (if any): Phys 301

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

7. Course Main Objective(s)

1. The student should get acquainted with the basic concepts of special functions, and transforms
2. The student should learn the basic properties of some important special functions.
3. The student should learn how to evaluate differential equations of special functions and how to solve their integrals and recurrence relations.
4. The students should learn how to use the mathematical concepts of this course in specific problems of physics.

1. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1.	Traditional classroom	45	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	45
2.	Laboratory/Studio	0
3.	Field	0
4.	Tutorial	0
5.	Others (specify)	0
	Total	45

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	Recognize appropriate tools and techniques that may be used to solve the problems.	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.
2.0	Skills			
2.1	Apply special functions and transformation to solve qualitative and quantitative problems.	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	Reconstruct mathematical equations based on those functions to be used in different situations	S2		
2.3	Find a specific form of special functions and transformations	S3		
3.0	Values, autonomy, and responsibility			

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
3.1	Work in a team and acknowledge others' work.	V1	• assignments. • Homework	Hold Class discussion

C. Course Content

No	List of Topics	Contact Hours
1.	Gamma and Beta functions	6
2.	Legendre, Applications of Legendre functions in electrostatics Associated Legendre, Applications of Legendre functions in magnetostatics and nuclear physics	6
3.	Spherical Harmonics, Applications in quantum theory of angular momentum and the quantum mechanics of the hydrogen atom	6
4.	Bessel functions of all types, Applications in the diffraction of waves, in electrodynamics, in propagation of waves, in quantum mechanics	6
5.	Hermite, Applications in the quantum mechanics of the simple harmonic oscillator	6
6.	Fourier integral transformations and their applications in physics.	5
7	Laplace Transformation. Applications in the physics of waves, heat transfer and in quantum mechanics	6
6.	Analytical continuation method and its application in the gamma function	2
7	Green function and its use in differential equations	2
Total		45

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	First Midterm examination	Approx. 6	15%
2.	Second Midterm examination	Approx. 12	15%
3.	Quiz	Throughout	10%
4.	Homework	Throughout	10%
5.	In-class discussion	Throughout	10%
6.	Final	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	Mathematical Methods for Physicists by George Arfken Hans Weber Frank E. Harris, 7th edition, 2012, Academic Press Mathematical Methods in the Physical Sciences by Mary L. Bose, 3rd edition, 2015, John Wiley & Sons.
Supportive References	Mathematical Methods for Physics and Engineering 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

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
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.	17th (2nd term/ 1445 H)
DATE	16/10/1445 H