Course Specification
(Bachelor)

Course Title:	Mathematical Physics 1
Course Code:	2033102-3
Program:	Bachelor in Physics
Department:	Physics Department
College:	College of Science
Institution:	Taif University
Version:	Version 1
Last Revision Date:	*Pick Revision Date.*

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: (3)					
2. Course type					
A.	☐ University	☐College	☒ Department	☐Track	☐ Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: (5th Level/ 3rd Year)					
4. Course general Description:					
The course introduces the basic of special function elements, including: Gamma Function. Beta Function. Error Function. Series Solutions of Differential Equations. Legendre Equation and Polynomials. Associated Legendre Functions. Bessel Functions. Hermite Functions. Laguerre Functions.					
5. Pre-requirements for this course (if any):					
Differential Equations for Physics (2032203-3)					
6. Co-requisites for this course (if any):					
None					
7. Course Main Objective(s):					
• To introduce students to the concepts and basics of Mathematical Physics. • To introduce students to special functions. • To point out the importance of Mathematical Physics in other disciplines. • To draw the attention of students to the applications of Mathematical Physics. • To teach the students the subjects needed as a prerequisite for Mathematical Physics 2. • To point out the importance of Mathematical Physics 1in scientific research.					

2. Teaching mode (mark all that apply)

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

No	Mode of Instruction	Contact Hours	Percentage
4	Distance learning	0	0%

3. 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	State the basic concepts and differentiate between special functions to be used in solving problems.	K1	Lecture	Written exam and Homework reports
1.2	Memorize the forms of special functions and recognize their Characteristics.	K1	Lecture Discussion	Written exam
2.0	**Skills**			
2.1	Solve different types of questions concerning special functions.	S2	Lectures	Written exam and Homework reports
2.2	Utilize critical thinking techniques to convert and relate physics problems	S1	Group's discussion	Written exam

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	to special functions.			
3.0	Values, autonomy, and responsibility			
3.1	Show responsibility for working independently and interacting with colleagues and staff to extract important information and identifying key issues to make progress	V1	Group discussion	Project
3.2	Use mathematical, numerical, statistical tools, information and communications technology and effective searching for needed information		Group discussion	Homework reports and projects
...				

C. Course Content

No	List of Topics	Contact Hours
1.	**Unit 1: Gamma Function:** ▪ Definition of the gamma function ▪ Recursion relation ▪ The gamma function of negative numbers ▪ Some important formulas involving gamma functions	6
2.	**Unit 2: Beta Function:** ▪ Definition of the beta function ▪ Formulas of the beta function ▪ The relation between the beta and gamma functions ▪ Some applications involving beta functions	6
3.	**Unit 3: Error Function:** ▪ Definition of the error function	4

	▪ Complementary error function ▪ Asymptotic series ▪ Some applications involving beta function (Stirling's formula)	
4.	**Unit 4: Series Solutions of Differential Equations:** ▪ Definition of the series solution (power series) ▪ Solving first and second order differential equations by power series method ▪ Series solution of Legendre differential equation.	5
5.	**Unit 5: Legendre Equation and Polynomials:** ▪ Definition of Legendre equation ▪ Legendre Polynomials ▪ Rodrigue's formula ▪ generating function for Legendre polynomials ▪ recursion relations ▪ Orthogonality and normalization of Legendre polynomials	4
6.	**Unit 6: Associated Legendre Equation:** ▪ Definition of Associated Legendre equation ▪ Associated Legendre functions ▪ Rodrigue's formula ▪ Orthogonality and normalization of Associated Legendre functions	3
7.	**Unit 7: Bessel Equation and Functions:** ▪ Definition of Bessel equation ▪ First and second solutions of Bessel's equation ▪ recursion relations ▪ Bessel functions ▪ Orthogonality and normalization of Bessel functions	6
8.	**Unit 8: Hermite Functions:** ▪ Definition of Hermite equation ▪ Hermite Polynomials ▪ Rodrigue's formula ▪ Generating function for Hermite polynomials ▪ Recursion relations ▪ Orthogonality and normalization of Hermite polynomials	4
9.	**Unit 9: Laguerre Functions:** ▪ Definition of Laguerre equation ▪ Laguerre Polynomials ▪ Rodrigue's formula ▪ Generating function for Laguerre polynomials	4

	▪ Recursion relations ▪ Orthogonality and normalization of Laguerre polynomials	
	Revision	**3**
	Total	**45**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Activities	Periodically	20%
2.	First periodical exam	8^{th}	15%
3.	Second periodical exam	13^{th}	15%
4.	Final exam	17^{th}	50%

*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	1- Mathematical Methods in the Physical Sciences, Mary L. Boas (1983).
Supportive References	1-Advanced Mathematics for Engineers and Scientists, Schaum's Outline Series (1917). 2-Mathematical Methods for Physicists, George Arfken (1970).
Electronic Materials	http://hyperphysics.phy-astr.gsu.edu/
Other Learning Materials	MATHEMATICA, MATHLAB

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Lecture room with max 60 seats
Technology equipment (projector, smart board, software)	data show, Smart Board, software
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	Indirect
Effectiveness of Students' assessment	Pear reviewer Program coordinator Departmental council Faculty council	Indirect
Quality of learning resources	Students Instructor Faculty	Indirect
The extent to which CLOs have been achieved	Program coordinator Instructor	Direct
Other		

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

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	**PHYSICS DEPARTMENT COUNCIL**
REFERENCE NO.	**NO. 4-45**
DATE	**27/09/2023 (12/03/1445)**

قسم الفيزياء
Physics Department
TU
جامعة الطائف
TAIF UNIVERSITY