هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

Course Specifications

Course Title:	**Mathematical Physics 1**
Course Code:	**2033102-3**
Program:	**Bachelor in Physics**
Department:	**Physics Department**
College:	**College of Science**
Institution:	**Taif University**

Table of Contents

A. Course Identification

1. Credit hours: 3
2. Course type **a.** University ☐ College ☐ Department ☑ Others ☐ **b.** Required ☑ Elective ☐
3. Level/year at which this course is offered: 7th Level/ 3rd Year
4. Pre-requisites for this course (if any)**: Differential Equations for Physics (2032203-3)**
5. Co-requisites for this course (if any)**: None**

6. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	**Traditional classroom**	5	100%
2	**Blended**	0	0%
3	**E-learning**	0	0%
4	**Distance learning**	0	0%
5	**Other**	0	0%

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	**Lecture**	50
2	**Laboratory/Studio**	0
3	**Tutorial**	0
4	**Others** (specify)	0
	Total	**50**

B. Course Objectives and Learning Outcomes

1. Course 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.

2. Course Main Objective

- 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.

3. Course Learning Outcomes

CLOs		Aligned PLOs
1	**Knowledge and understanding**	
1.1	State the basic concepts and differentiate between special functions to be used in solving problems.	K1
1.2	Memorize the forms of special functions and recognize their Characteristics.	K1
2	**Skills:**	
2.1	Solve different types of questions concerning special functions.	S2
2.2	Utilize critical thinking techniques to convert and relate physics problems to special functions.	S1
3	**Values:**	
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
3.2	Use mathematical, numerical, statistical tools, information and communications technology and effective searching for needed information.	

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 ▪ Complementary error function ▪ Asymptotic series ▪ Some applications involving beta function (Stirling's formula)	4
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.	4
5	**Unit 5: Legendre Equation and Polynomials:** ▪ Definition of Legendre equation ▪ Legendre Polynomials	6

	▪ Rodrigue's formula ▪ generating function for Legendre polynomials ▪ recursion relations ▪ Orthogonality and normalization of Legendre polynomials	
6	**Unit 6: Associated Legendre Equation:** ▪ Definition of Associated Legendre equation ▪ Associated Legendre functions ▪ Rodrigue's formula ▪ Orthogonality and normalization of Associated Legendre functions	4
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	6
9	**Unit 9: Laguerre Functions:** ▪ Definition of Laguerre equation ▪ Laguerre Polynomials ▪ Rodrigue's formula ▪ Generating function for Laguerre polynomials ▪ Recursion relations ▪ Orthogonality and normalization of Laguerre polynomials	5
	Revision	3
Total		50

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	State the basic concepts and differentiate between special functions to be used in solving problems.	Lecture	Written exam and Homework reports
1.2	Memorize the forms of special functions and recognize their characteristics.	Lecture Discussion	Written exam

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
2.0	**Skills**		
2.1	Solve different types of questions concerning special functions.	Lectures	Written exam and Homework reports
2.2	Utilize critical thinking techniques to convert and relate physics problems to special functions.	Group's discussion	Written exam
3.0	**Values**		
3.1	Show responsibility for working independently and interacting with colleagues and staff to extract important information and identifying key issues to make progress	Group discussion	Project
3.2	Use mathematical, numerical, statistical tools, information and communications technology and effective searching for needed information	Group's discussion	Homework reports and projects

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Activities	Periodically	10%
2	Midterm exam	6^{th}	30%
3	Short exam	9^{th}	10%
4	Final exam	12^{th}	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 :
6 Hours per week during office hours, in the instructor's office or by appointment.

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	Mathematical Methods in the Physical Sciences, Mary L. Boas (1983).
Essential References Materials	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. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	Lecture room with max 60 seats
Technology Resources (AV, data show, Smart Board, software, etc.)	data show, Smart Board, software
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	Indirect
Evaluation of Teaching	Pear reviewer Program coordinator Departmental council Faculty council	Indirect
Improvement of Teaching	Program coordinator Relevant committee	Direct
Quality of learning resources	Students Instructor Faculty	Indirect
Extent of achievement of course learning outcomes,	Program coordinator Instructor	Direct
Course effectiveness and planning for improvement	Program coordinator Instructor	Indirect

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	Department Council / Committee of academic development l
Reference No.	
Date	October 2, 2022