Course Specification
(Bachelor)

Course Title:	**Mathematical Physics (1)**
Course Code:	**PHY 1233**
Program:	**Bachelor of Science in Physics**
Department:	**Physics**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**
Version:	4
Last Revision Date:	***26/09/2024***

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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: (Level 4/ Year2)					
4. Course General Description:					
This course aims to teach how to use a mathematical methods (tools) to solve and explain many problems in physical sciences. The mathematical methods covered in this course include ordinary differential equations, Laplace and Fourier transforms, special function. The course will cover some mathematical techniques commonly used in physics. This is not a course in pure mathematics, but rather on the application of mathematics to solve and explain different problems in physics.					
5. Pre-requirements for this course (if any)**:**					
Calculus (3), MAT 1203					
6. Co-requisites for this course (if any)**:**					
7. Course Main Objective(s):					

- **Learn and understand the basic knowledge of ordinary differential. equations, Laplace and Fourier transforms, and special functions.**
- **Demonstrate competence with a wide variety of mathematical tools and techniques.**
- **Demonstrate a breadth of general knowledge in mathematical physics as well as depth in topics covered in this course.**
- **Apply mathematical concepts and techniques into the different problems in physics.**

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	60	100%
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		

No	Mode of Instruction	Contact Hours	Percentage
4	Distance learning		

3. 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 PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	**State the basic knowledge of ordinary differential equations and methods for their solution.**	**K1, K2**	• Lectures. • Tutorials. • Class discussions.	▪ Exams. ▪ Participation. ▪ Discussions.
1.2	**Describe the Laplace and Fourier transforms**.	**K1, K2**	• Lectures. • Tutorials. • Class discussions.	▪ Exams. ▪ Homework. ▪ Quizzes.
1.3	**Outline the basic concepts of the special functions.**	**K1, K2**	• Lectures. • Class discussions. • Tutorials.	▪ Participation. ▪ Exams. ▪ Discussions. ▪ Homework.
2.0	**Skills**			
2.1	**Explain and summarize the basic knowledge gained from studying waves and optical physics.**	**S1, S2**	▪ Lectures. ▪ Class discussions. ▪ Tutorials.	▪ Exams. ▪ Discussions. ▪ Participation.
2.2	**Develop the students ability to solve and analyze problems in physics related the topics covered by the course.**	**S2, S3**	▪ Problem classes and group tutorial. ▪ Homework assignments as well as problems solutions.	▪ Exams. ▪ Discussions. ▪ Homework.
2.3	**Communicate in a clear and concise manner**	**S4, S5**	• Lectures. • Class discussions.	▪ Exams.

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
	orally, and using IT for acquiring and analyzing information.		• Tutorials. • Encourage students to use electronic mail and internal network for submitting homework and assignments. • Use digital library.	▪ Participation and activities of students in the course community and blackboard. ▪ Homework.
3.0	**Values, autonomy, and responsibility**			
3.1	**Show the collaboration and inter-professionalism in class discussions or team works, as well as solve problems independently.**	**V1, V2, V3**	• Small team tasks • Open discussion at classroom. • Office hours.	▪ Participation. ▪ Homework. ▪ Mini-project(s).

C. Course Content

No	List of Topics	Contact Hours
1.	**First order differential equations:** Definitions, Separable equations, Homogeneous equations, Linear differential equations, Exact differential equations, Integrating Factor. Applications.	**14**
2.	**Second order linear differential equations with constants coefficients:** Definitions: difference between linear and non-linear, Homogeneous equations with constant coefficients Non-homogeneous equations. Variation of parameters (general method). Applications.	**14**
3.	**Integral Transforms:**Laplace transforms (LTs), properties of LT, Laplace transform of derivatives, Inverse Laplace transform. Applications.	**12**
4.	**Fourier series and Fourier transforms:**Fourier Sine – Cosine transform-complex Fourier transform. Fourier transform – inversion theorem-Fourier transform of derivatives, Convolution theorem, momentum representation. Applications.	**10**
5.	**Special Functions:**Introduction, The factorial function, Definition of the Gamma function; Recursion relation, The Gamma function of negative numbers, Some important formulas involving gamma functions, Beta functions, Beta functions in terms of Gamma functions, The simple pendulum, The error function, Asymptotic series, Stirling's formula, Elliptic integrals and functions.	**10**
Total		**60**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Class Activities (class quizzes, homework, solving problems, etc.....)	weekly	10 %
2.	Midterm Exam 1	6th week	25 %
3.	Midterm Exam 2	12th week	25 %
4.	Final Exam	16th week	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	-Chow T., ***Mathematical Methods for Physicists: A Concise Introduction***, Cambridge University Press (2000). -Riley K.F., Hobson M.P., and Bence S.J., ***Mathematical Methods for Physics and Engineering***, 3th Edition, Cambridge University Press, 2006.
Supportive References	Boas M.L. ***Mathematical Methods in the Physical Sciences***, 3rd Edition, John Wiley (2006).
Electronic Materials	**https://units.imamu.edu.sa/colleges/en/science/Pages/default.aspx**
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	- **Classrooms.**
Technology equipment (projector, smart board, software)	- **Classroom equipped with a whiteboard and a projector.**
Other equipment (depending on the nature of the specialty)	

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	**Students** **Second examiner**	**Indirect (The students complete the evaluation forms at the end of term.**

Assessment Areas/Issues	Assessor	Assessment Methods
		Final exam is evaluated by the second examiner)
Effectiveness of Students assessment	**Instructors**	**Direct (exams, HW, project, …)**
Quality of learning resources	**Faculty Students**	**indirect (surveys)**
The extent to which CLOs have been achieved	**Instructors Program Leaders**	**Direct (excel sheet)**
Other		

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

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	**Quality Unit-Physics Department**
REFERENCE NO.	**Department council No. 06**
DATE	**26/09/2024**