Al al-Bayt University
Qality and Assurance Department

بسم الله الرحمن الرحيم

جامعة آل البيت

Faculty of Science
Physics Department

Course Outline of Mathematical Physics I

1. Instructor's Information

Instructor's / Coordinator's Name:	Prof. Hatem Widyan
Office Hours:	10-11, 12-1: Sunday, Tuesday, Thursday
Office and Phone:	Bukhari 2nd Floor (2172)
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Research and Teaching Assistant / Supervisor / Technical (if any):	NA

2. Course Information

Course No.: 402281	Course Title: Mathematical Physics 1	Level: 2rd yr
Course Type: Theoretical	Prerequisite: Calculus II	Class Time: 9:00-10:00
Academic Year:2019-2020	Semester: Fall	Study hours:

3. Course Description

This is an Introductory course in mathematical physics for students who already took successfully Calculus II and General Physics II. We begin by reviewing the concept of the vector. After that introduce gradient, divergence, and curl and give their physical meaning and their applications in physics. We discuss Gauss and Stokes Theorems. Transformations between the three coordinates (Cartesian, spherical, cylindrical) are discussed. Separation of variables. The concept of complex numbers is introduced. How to add, subtract, multiply, divide complex numbers is discussed. Determinants and matrices are defined and their applications is discussed. Solving first and second order ordinary differential equations is introduced, Finally, we discuss Fourier series and learn how to expand periodic functions.

4. Course Objectives:

a-	Review the vectors. Discuss the calculus of vectors. Define gradient, divergence and curl of vector and other related concepts.
b-	Introduce different coordinate systems and the relation between them.
c-	Discuss complex numbers. Finding their roots and how to add, multiply and divide them.
d-	Introduce determinants and matrices and their applications to physical problems.
e-	Learn how to solve first and second order ordinary differential equations.
f-	Use Fourier series to expand and periodic function in terms of sine and cosine.

5. Course Learning Outcomes (CLO)

(Knowledge, Skills, and Competencies) (K,S,C)

Upon successful completion of the course, the students will be able to:

CLO 1: Define various quantities related to the course. (K)
CLO 2: Recognize the basic characteristics and properties of vectors. (K)
CLO 3: Solve problems using Gauss and Stokes Theorems. (S)
CLO 4: Evaluate physical quantities using the suitable coordinate system. (S,C)
CLO 5: Define complex numbers and apply them in physics. (S,C)
CLO 6: Apply determinants and matrices to solve set of linear physical equations. (S)
CLO 7: Solve the first and second order ordinary differential equations. (S,C)
CLO 8: Expand periodic functions in terms of sine and cosine using Fourier series.(S)

6. Course Content

Week	Topic	Comments	Course Outcome
1	**CHAPTER : OVERTURE**	We review the concept of vectors	CLO1+CLO2
2-6	**Chapter 1: Vector Analysis** ➢ Vector differentiation and integration ➢ Gradient, divergence, curl ➢ Gauss's and Stokes' theorems ➢ Potential theory	To define the vector in using rotation of axis. We learn how multiply three vectors. We define vector operators and use them to solve physical problems. Potential theory is formulated and learn how to calculate them	CLO1+CLO2 +CLO3

7-9	**Chapter 2: Curvilinear Coordinates** ➢ Review of Cartesian coordinates ➢ Spherical coordinates ➢ Cylindrical coordinates ➢ Transformation between coordinates ➢ Separation of variables	To evaluate a physical quantity involves either integration or solving differential equations. We discuss different coordinates depending on the symmetry of the problems to ease calculating physical quantities. Separation of variables is used solve some types of partial differential equations.	CLO1+CLO4
~FIRST EXAM ON OCTOBER 31 2019 (Thursday) 25%			
10-11	**Chapter 3: Complex Numbers** ➢ Graphical representation of complex conjugate ➢ Algebraic operations ➢ De Moivre's formula ➢ Powers and roots of complex numbers ➢ Functions of complex variables	In this chapter, we discuss complex numbers and how to represent them in polar form. We learn how to add, subtract, multiply and divide complex numbers, as well as finding their roots. Functions of complex numbers are also introduced and discussed.	CLO1+CLO5
SECOND EXAM ON DECEMBER 01 2019 (SUNDAY) 25%			
12	**Chapter 4: Determinants** ➢ Definitions and properties ➢ Laplace's development by minors ➢ Set of a set of homogeneous and nonhomogenous equations	Determinants are defined and we learn how to use them in solving a set of linear algebraic equations.	CLO1+CLO6
13	**Chapter 5: Matrices** ➢ Basic definitions ➢ Laws and properties of series ➢ Special matrices ➢ Trace ➢ Eigenvalues and eigenvectors ➢ Diagonalization	Matrices have a wide applications in physics. So, we learn how to use them is solving some problems.	CLO1+CLO6
14	**Chapter 6: Ordinary Differential Equations** ➢ Special first order differential equations ➢ Second order linear differential equations ➢ Method of variation of parameters ➢ Other second order differential equations	Many physical laws are written as a differential equation. So, it is a must for students to learn how to solve them. We discuss first as well as second order ordinary differential equations.	CLO1+CLO7

15	**Chapter 7: Fourier Series** ➢ Introduction and useful integrals ➢ Calculus of Fourier coefficients ➢ Complex form	We discuss how to expand periodic functions of any period in terms of sine and cosine. We introduce different forms of Fourier series.	CLO1+CLO8
16	Review	Review	**Final Exam**

7. Teaching and Learning Strategies and Evaluation Methods

No.	Learning Outcomes	Teaching Strategies	Learning Activities	Evaluation /Measurement Method (Exam/ presentations/ discussion/ assignments)
1	(CLO1)	trad. lect.	Discussion & Problem Solving	HW & First Exam & Final Exam
2	(CLO2)	trad. lect.	Discussion & Problem Solving	HW & First Exam & Final Exam
3	(CLO3)	trad. lect.	Discussion & Problem Solving	HW & Second Exam & Final Exam
4	(CLO4)	trad. lect.	Discussion & Problem Solving	HW & Second Exam & Final Exam
5	(CLO5)	trad. lect.	Discussion & Problem Solving	HW & Final Exam
6	(CLO6)	trad. lect.	Discussion & Problem Solving	HW & Final Exam

8. Assessment

Methods Used	Assessment Time	Distribution of grades
1- Semester work (report, assignments, attendance)	During semester	00%
3- First Exam	Sixth week	25%
3- Second Exam	Tenth	25%
4- Final Exam	Week of the final exams	50%

9. Textbook

Main Reference	**Introduction to Mathematical Physics**
Author	**N.M. Laham and N.Y. Ayoub**
Publisher	-
Year	2004
Edition	2^{nd} (or any Edition)
Textbook Website	-

10. Extra References (books and research published in periodicals or websites)

1-	Mathematical Methods in the Physical Sciences, Mary L. Boas, Third Edition, John Wiley & Sons, 2006.
2-	Mathematical Methods for Physicists, George Arfken and Hans J. Weber, Fifth Edition, Academic Press, 2000.