



# Course Specification

## (Bachelor)

Course Title: **Electromagnetism**

Course Code: **PHYS 0324**

Program: **PHYSICS**

Department: **PHYSICS**

College: **Science**

Institution: **Majmaah University**

Version: **1**

Last Revision Date: **29/12/2024**



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## A. General information about the course:

### 1. Course Identification

#### 1. Credit hours: ( 3,0,0)

3

#### 2. Course type

A.  University  College  Department  Track  Others  
 B.  Required  Elective

#### 3. Level/year at which this course is offered: ( 5<sup>th</sup> / 3<sup>rd</sup> )

#### 4. Course General Description:

This course introduce the basic concepts in electromagnetic phenomena, such as: Vector Calculus; Electrostatic Fields; Applications of Gauss's Law, Poisson's Equation and Laplace's Equation; Magnetostatic field, Ampère's Law, Electromagnetic Induction, Faraday's Law, Maxwell's Equations in vacuum and in matter; Conservation Laws and the Continuity Equation, Electromagnetic Waves in Matter; Absorption and Dispersion of Electromagnetic Waves.

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

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

Nil

#### 7. Course Main Objective(s):

This course introduce the basic concepts in electromagnetic phenomena. This course aim to:

- 1- Introduce the basic concepts of electromagnetic fields.
- 2- Providing the Divergence and curls of electric and magnetic fields.
- 3- Extend student knowledge in Electromagnetic Waves in vacuum and matter.
- 4- Study the Gauss's law, Poisson's Equation, Laplace's Equation, Ampère's Law and Faraday's Law.
- 5- Describe the absorption, reflection and dispersion of electromagnetic waves in conductors.

### 2. Teaching mode (mark all that apply)





No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	45	100%
2	E-learning		
3	Hybrid <ul style="list-style-type: none"> <li>Traditional classroom</li> <li>E-learning</li> </ul>		
4	Distance learning		

### 3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	Lectures	45
2.	Laboratory/Studio	
3.	Field	
4.	Tutorial	
5.	Others (specify)	
<b>Total</b>		<b>45</b>

## 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
<b>1.0</b>	<b>Knowledge and understanding</b>			
1.1	Explain the Gauss's law, Ampère's Law and Faraday's Law.	K1	Direct teaching: Lectures Presentations discussions Indirect teaching: Peer Learning	Quiz Assignment Mid term exams Final exams
1.2	Describe how Maxwell's equations predict the relative directions of the electric fields and magnetic fields, speed and the direction of	K1 , K2	Direct teaching: Lectures Presentations discussions Indirect teaching: Peer Learning	Quiz Assignment Mid term exams Final exams



Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
	propagation of plane electromagnetic waves			
1.3	Describe the absorption, reflection and dispersion of electromagnetic waves in conductors.	K2	Direct teaching: Lectures Presentations discussions Indirect teaching: Peer Learning	Quiz Assignment Mid term exams Final exams
<b>2.0</b>	<b>Skills</b>			
2.1	Ability to apply mathematics tools to find divergence and curls of electric and magnetic fields.	S2 & S4	Direct teaching: Lectures Presentations discussions Indirect teaching: Peer Learning	Quiz Assignment Mid term exams Final exams
2.2	Ability to solve Maxwell's equations in free space and matter.	S2 & S4	Direct teaching: Lectures Presentations discussions Indirect teaching: Peer Learning	Quiz Assignment Mid term exams Final exams
2.3	Calculate the Poynting vector and the energy density of electromagnetic waves.	S2	Direct teaching: Lectures Presentations discussions Indirect teaching: Peer Learning	Quiz Assignment Mid term exams Final exams
<b>3.0</b>	<b>Values, autonomy, and responsibility</b>			
3.1	Work collaboratively and constructively and lead diverse teams to perform a wide range of tasks with responsibility and play a major role in joint work planning and evaluation.	V1	Direct teaching: Lectures Presentations discussions Indirect teaching: Peer Learning	Quiz Assignment Mid term exams Final exams
3.2	Manage tasks and activities related to the discipline and work in a	V2	Direct teaching: Lectures Presentations	Quiz Assignment





Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
	professional manner and with autonomy.		discussions Indirect teaching: Peer Learning	Mid term exams Final exams

### C. Course Content

No	List of Topics	Contact Hours
1.	<b>Coordinates Systems:</b> Cartesian Coordinates, Spherical Coordinates, Cylindrical Coordinates. <b>Vector Calculus:</b> The Del Operator, Gradient, The Divergence of a vector and divergence theorem, The Curl and Stock's theorem, Product Rules, Second Derivatives.	6
2.	<b>Divergence and Curl of Electrostatic Fields:</b> Field Lines, Flux, and Gauss's Law, The Divergence of electric field, Applications of Gauss's Law, The Curl of electric field, Electric Potential, Poisson's Equation and Laplace's Equation.	6
3.	<b>The Divergence and Curl of magnetostatic field:</b> Straight-Line Currents, The Divergence and Curl of magnetostatic field, Ampère's Law, Comparison of Magnetostatics and Electrostatics, Magnetic Vector Potential: The Vector Potential, Boundary Conditions, Multipole Expansion of the Vector Potential	6
4.	<b>Electromagnetic Induction:</b> Faraday's Law, The Induced Electric Field, Inductance, Energy in Magnetic Fields.	3
5.	<b>Maxwell's Equations:</b> Electrodynamics Before Maxwell, How Maxwell Fixed Ampère's Law, Maxwell's Equations in Vacuum, Magnetic Charge, Maxwell's Equations in Matter, Boundary Conditions.	6
6.	<b>Conservation Laws:</b> The Continuity Equation, Poynting's Theorem, Newton's Third Law in Electrodynamics, Maxwell's Stress Tensor, Conservation of Momentum.	3
7.	<b>Electromagnetic Waves in Vacuum:</b> The Wave Equation for electric and magnetic fields, Monochromatic Plane Waves, Energy and Momentum in Electromagnetic Waves.	3
8.	<b>Electromagnetic Waves in Matter:</b> Propagation in Linear Media, Reflection and Transmission at Normal Incidence, Reflection and Transmission at Oblique Incidence.	6
9.	<b>Absorption and Dispersion:</b> Electromagnetic Waves in Conductors, Reflection at a Conducting Surface, The Frequency Dependence of Permittivity.	6
<b>Total</b>		<b>45</b>

### D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Quizzes	4 & 8	10%
2.	Mid 1	7	15%
3.	Assignments	2-10	10%



No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
4	Mid 2	10	15%
5	E-Exam	12	10%
6	Final exam	15	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	INTRODUCTION TO ELECTRODYNAMICS 4th edition. David J. Griffiths, 2013.
Supportive References	Elements of electromagnetics, MATTHEW N. O. SADIKU, 2018.
Electronic Materials	
Other Learning Materials	

### 2. Required Facilities and equipment

Items	Resources
<b>facilities</b> (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	<b>Classrooms</b>
<b>Technology equipment</b> (projector, smart board, software)	<b>Projector, smart board</b>
<b>Other equipment</b> (depending on the nature of the specialty)	

## F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students/ internal committee	Direct (Student evaluation electronically organized by Deanship of registration and admission)/ Verification of students' papers
Effectiveness of students' assessment	Staff members (Peer Reviewer)	Indirect (Frequent meetings and consultation among the teaching staff)
Quality of learning resources	Staff members (Peer Reviewer)	Indirect (Frequent meetings and consultation among the teaching staff)



Assessment Areas/Issues	Assessor	Assessment Methods
The extent to which CLOs have been achieved	Staff members (Peer Reviewer)	Direct (Meeting between course coordinators and the tutors)

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

**Assessment Methods** (Direct, Indirect)

### G. Specification Approval

<b>COUNCIL /COMMITTEE</b>	
<b>REFERENCE NO.</b>	<b>1</b>
<b>DATE</b>	<b>29/12/2024</b>

