Faculty: Faculty of Science	
Department: Physics department	**Program: M. Sc. of Physics**
Academic year: 2023/2024	**Semester: Second**

Course Plan

First: Course Information

Course No. **0302721**	***Course Title:*** **Advanced Electrodynamics 1**	***Credit Hours: 3***
Prerequisite: **None**	***Section No.: 1***	***Lecture Time:***
Type Of Course:	***Mandatory Faculty Requirement*** ☐ ***Optional University Requirement*** ☐ ***Mandatory University Requirement*** ☐ ***Faculty Requirement*** ☐ ***Ancillary Course*** ☐ ***Optional Specialty Requirement*** ■ ***Mandatory Specialization requirement*** ☐	
Type of Learning:	☐ ***Face-to-Face Learning*** ☐ ***Blended Learning (2 Face-to-Face + 1 Asynchronous)*** ■ ***Online Learning (2 Synchronous+1 Asynchronous)***	

Second: Instructor's Information

Name: Dr. Mohammed Hassen Abu-Sei'leek			***Academic Rank:*** **Assistant Professor**		
Office Number: 318D			***Phone Number:1095***		***Email:*** **mseileek@zu.edu.jo**
Office Hours:	***Sunday 2:00-3:00***	***Monday 11:00-12:00***	***Tuesday 2:00-3:00***	***Wednesday 11:00-12:00***	***Thursday 2:00-3:00***

Third: Course Description

In this course, students will cover topics such as Introduction for electrostatic, Boundary-value problems in electrostatics, Multi-Poles, Magneto statics, Maxwell's equations.

Fourth: Course Objectives

Upon successful completion, students will have the knowledge and skills to:

1. Have an advanced understanding of Maxwell's equations and have gained practical experience in solving Maxwell's equations using analytic and numerical techniques.
2. Understand the wave solutions of electromagnetism and their relevance to optics including propagation of electromagnetic waves in materials, birefringence, boundary conditions at material interfaces and reflection and transmission of waves at interfaces, polarization, spatial phase, coherence, Fourier theory and spatial filtering, Maxwell stress tensor and mechanical forces exerted by electromagnetic waves, radiation from time dependent charge distributions.
3. Covariant (relativistic formulation) of electrodynamics including four vectors, the electromagnetic field tensor, Lagrangians and fields, gauge transformations and symmetries.
4. Apply the covariant formulation of electricity and magnetism to bremsstrahlung and related effects
5. Explain the purpose and advantages of writing physical laws in tensor form.
6. Demonstrate effective oral and written communication skills and be able to research and explain scientific concepts.

Fifth: Learning Source

Main Reference:	***Classical electrodynamics, 3rd edition, J. D. Jackson, Wiley, ISBN-10: 8126510943.***	***Publication Year:1998***
	1. ***Modern Electrodynamics, Andrew Zangwill. Cambridge University Press, ISBN-9788521896979*** 2. ***Modern Electrodynamics, A. Zangwill, Cambridge University Press, ISBN-9788521896979***	1. ***Year: 2012*** 2. ***Year: 2023***
Additional Sources & Websites:	1. ***https://www.damtp.cam.ac.uk/user/tong/em.html*** 2. ***https://www.phys.ksu.edu/personal/wysin/ED-I/index.html*** 3. ***https://www.wtamu.edu/~cbaird/courses.html***	
Teaching Type:	☐ ***Classroom*** ☐ ***Laboratory*** ☐ ***Workshop*** ■ ***MS Teams*** ■ ***Moodle***	

Sixth: Learning Outcomes

Number	***Course learning output***	**Associated PILOs Code** Choose one PILO for each CILO*	**Assessment method**** Choose at least two methods	**Scores out of 100** State the total score identified for each CILO	***Minimum acceptable Score/percentage (%)*** *The percentage should not be less than 50%* ***
Knowledge					

K1	To understand the principles of electrostatic, Boundary-value problems in electrostatics, Multi-Poles, Magneto statics, Maxwell's equations..	PK1	Homework Quiz Final exam	10	5(50%)
K2	Demonstrate the basic knowledge about the Coulomb's law, electric field, Gauss's law, differential form of Gauss's law, scalar potential, surface distributions of charges and dipoles, Poisson's and Laplace's equations, Green's theorem, Uniqueness theorem and Green's function and electrostatic potential energy.	PK2	Homework Quiz Final exam	10	5(50%)
K3	To understand the fundamental method of images, point charge and a ground conducting sphere, point charge and a charged, insulated, conducting sphere, at fixed potential and in a uniform field, method of inversion, Green's function for a sphere, conducting sphere with hemispheres at different potentials, orthogonal function and expansions, and separation of variables in rectangular coordinates.	PK3	Homework Quiz Final exam	12	6(50%)
K4	To understand Laplace's equation in spherical coordinates, Legendre polynomials, boundary-value problems with azimuthal symmetry, spherical harmonics, addition theorem for spherical harmonics, cylindrical coordinates, Bessel functions, boundary-value problems in cylindrical coordinates, expression of Green's function in spherical coordinates, use of spherical Green's function expansion, expansion of Green's function in cylindrical coordinates, eigenfunction expression for Green's functions, and mixed boundary conditions, charged conducting disc.	PK4	Homework Quiz Final exam	12	6(50%)
Skills					
S1	Applying a mathematical concept such as calculus, differential equations, linear algebra, and complex analysis. These	PS1	Homework Quiz Final exam	16	8(50%)

	mathematical tools are essential for understanding the theoretical framework of electrodynamic				
S2	Creating links between the principles and ideas of multipoles, electrostatic of macroscopic media, dielectric.	PS2	Homework Quiz Final exam	12	6(50%)
S3	Build a strong background electrodynamic for delving into advanced fields of study like quantum, spectroscopy, nanotechnology, photonics, and among others.	PS3	Homework Quiz Final exam	12	6(50%)
S4	Develop theoretical models to describe the time-varying fields, Maxwell's equations and conservation laws. This may involve solving the Time-Varying Fields for Gauge transformation and Green's function problem, Kirchhoff's integral representation.	PS4	Homework Quiz Final exam	16	8(50%)
Competences					
C1	Students should accept full responsibility for their own learning.	PC1	Homework Take home Exam		
C2	Working a knew problems and identify the suitable way to solve the problem.	PC2	Homework Take home Exam		

***Refer to document () and page 2 in document ()**
**** Refer to document ()**
****80% of the students must achieve the minimum acceptable percentage or higher for each CILO**

Seventh: Course Structure

Lecture Date	Teaching Outcomes (ILOs)	Topics	Teaching Procedures*	Teaching Methods***	References***
03/03/2024	PK1 PK2 PK4 PS2 PC1	**Introduction:** Boundary-value problems in electrostatics, Multi-Poles,..	Synchronous	Online Lecture on Microsoft Teams	Text book Chapter 1

10/03/2024	PK1 PK2 PS1 PS2 PS4 PC1 PC2	Magneto statics, Maxwell's equations	Asynchronous	Students' Activities on Moodle	Text book Chapter 1
17/03/2024	PK1 PK2 PS2 PS4 PC1 PC2	the Coulomb's law, electric field, Gauss's law, differential form of Gauss's law, scalar potential, surface distributions of charges and dipoles.	Synchronous	Online Lecture on Microsoft Teams	Text book Chapter 1
24/03/2024	PK1 PK2 PS2 PC1 PC2	method of images, point charge and a ground conducting sphere, point charge and a charged, insulated, conducting sphere, at fixed potential and in a uniform field, method of inversion,	Asynchronous	Students' Activities on Moodle	Text book Chapter 2
31/03/2024	PK1 PK2 S1 PS2 PC1 PC2	Green's function for a sphere, conducting sphere with hemispheres at different potentials, orthogonal function and expansions, and separation of variables in rectangular coordinates	Synchronous	Online Lecture on Microsoft Teams	Text book Chapter 2
07/04/2024	PK1 PK2 PS1 PS2 PS4 PC1 PC2	Laplace's equation in spherical coordinates, Legendre polynomials, boundary-value problems with azimuthal symmetry, spherical harmonics, addition theorem for spherical harmonics, cylindrical coordinates, Bessel functions,.	Asynchronous	Students' Activities on Moodle	Text book Chapter 3
14/04/2024	PK1 PK2 PS2 PS4 PC1 PC2	boundary-value problems in cylindrical coordinates, expression of Green's function in spherical coordinates, use of spherical Green's function expansion, expansion of Green's function in cylindrical coordinates, eigenfunction expression for Green's functions, and mixed boundary conditions, charged conducting disc	Synchronous	Online Lecture on Microsoft Teams	Text book Chapter 3

21/04/2024	PK1 PK2 PS1 PS2 PS4 C1 PC2	Multipole expansion, multipole expression of the energy of a charge distribution in an external field, macroscopic electrostatic, simple dielectric and boundary conditions.	Asynchronous	Students' Activities on Moodle	Text book Chapter 4
28/04/2024	PK1 PK2 PK4 PS2 PC1 PC2	Boundary-value problem with dielectrics, molecular polarizability and electric susceptibility, models for molecular polarizability and electrostatic energy in dielectric media	Synchronous	Online Lecture on Microsoft Teams	Text book Chapter 4
05/05/2024	PK1 PK2 PK4 PS2 PS4 PC1	Introduction and definitions of magnetostatics, Biot and Savart law, differential equations of magnetostatics, Ampere's law, vector potential, magnetic induction of a circular loop of energy, localized current distribution, magnetic moment	Asynchronous	Students' Activities on Moodle	Text book Chapter 5
12/05/2024	PK1 PK2 PS2 PC1	Force and torque on localized currents in an external field, macroscopic equations, boundary conditions, uniformly magnetized sphere, magnetized sphere in an external field, permanent magnets, magnetic shielding	Synchronous	Online Lecture on Microsoft Teams	Text book Chapter 5
19/05/2024	PK1 PK2 PS2 PC1	Faraday's law of induction, energy in the magnetic field, Maxwell's displacement current, Maxwell' equation, vector and scalar potentials, wave equations, gauge transformations.	Asynchronous	Students' Activities on Moodle	Text book Chapter 6
26/05/2024	PK1 PK2 PS2 PC1	Green's function for the time-dependent wave equation, initial-value problem, Kirchoff's integral representation, poynting's theorem, conservation laws, macroscopic equations.	Synchronous	Online Lecture on Microsoft Teams	Text book Chapter 6
12/06/2024	**Final Exam**				

* Learning procedures: (Face-to-Face, synchronous, a synchronous). * * Teaching methods: (Lecture, video…..). ** * Reference: (Pages of the book, recorded lecture, video….).

Eighth: Assessment methods

Methods	Fully Electronic Education	Integrated Teaching	Direct Teaching	Specific Course Output to be measured *State the score identified for each CILO for each method of assessment out of 100 **If any CILO will not be assessed in the course, mark NA.							
				K1	K2	K3	K4	S1	S2	S3	S4
Quiz (short quizzes, seminar, projects, …)	60			**6**	**6**	**7**	**7**	**6**	**8**	**2**	**4**
Final Exam	**40**			**4**	**4**	**5**	**5**	**10**	**4**	**10**	**12**
Total out of 100	**100**			**10**	**10**	**12**	**12**	**16**	**12**	**12**	**16**

Ninth: Course Policies

- Meeting the deadline for the lecture.
- Commitment to interaction and participation.
- Interactive lectures will be given through a platform (MS Teams).
- Duties and tests will be given through a platform (Moodle).
- Commitment to the right appearance in front of the camera with the proper background.
- University regulations for attendance and absence from lectures and examinations are in force.
- Academic Integrity: Fraud or moral impersonation are unacceptable and are punishable according to university regulations and instructions.

Approved by:	Name	Date	Signature
Head of Department	Dr. Riad Masharfe		
Faculty Dean	Dr. Aliaa Burqan		