Course Specification

(Postgraduate Programs)

Course Title:	Classical Electrodynamics
Course Code:	PHYS602
Program:	**Master of Science in Physics**
Department:	**Physical Sciences**
College:	**Science**
Institution:	**Jazan University**
Version:	
Last Revision Date:	20/4/2024

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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
B.	☒ Required		☐Elective	
3. Level/year at which this course is offered: (Level 1 / year 1)				
4. Course general Description: **This course provides a rigorous foundation for advanced classical electrodynamics and some of its applications. It covers the physics and classical mathematics necessary to understand electromagnetic fields in materials and at surfaces and interfaces. Particular focus is given to time-dependent phenomena in which the calculation of the time-dependent scalar and vector potentials, and electric and magnetic fields, can be traced to the Green function formalism. The course develops a good knowledge on the Boundary–Value Problems in Electrostatics, Multipoles, Electrostatics of Macroscopic Media, Dielectric, Magnetostatics, Time-Varying Fields, Maxwell's Equations.**				
5. Pre-requirements for this course (if any)**:** Non				
6. Co-requirements for this course (if any)**:** Non				
7. Course Main Objective(s):				

The main objectives of this course are focused on the following:

- **Demonstrate knowledge of fundamental concepts of classical electrodynamics.**
- **State and deal with the fundamental problems and theories of classical electrodynamics.**
- **Develop physical intuition, mathematical reasoning, and problem-solving skills.**
- **Apply the theory to discuss quantum phenomena quantitatively.**
- **Solve a wide range of specific theoretical problems.**

2. Teaching Mode: (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	45	100%
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		
4	Distance learning		

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

No	Activity	Contact Hours
1.	**Lectures**	45
2.	**Laboratory/Studio**	0
3.	**Field**	0
4.	**Tutorial**	0
5.	**Others (specify)……**	0
	Total	45

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods:

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding: Upon completing the course students will be able to**			
1.1	State the physical phenomena of classical electrodynamics.	PLO1.1	Lectures, Tutorials, Seminars, and Interactive Discussions.	**Direct**: In class interactive questioning, quizzes, written exams **Indirect**: student survey
1.2	Define expressions for the energy, Potentials, and electric fields both for the electrostatic and Magnetostatics fields	PLO1.1	Lectures, Tutorials, Seminars, and Interactive Discussions.	**Direct**: In class interactive questioning, quizzes, written exams

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	and derive Pointing's theorem from Maxwell's equations.			**Indirect**: student survey
...				
2.0	**Skills: Upon completing the course students will be able to**			
2.1	Derive and explain the fundamental topics gained from studying classical electrodynamics course.	PLO2.1	Lectures, Tutorials, Seminars, and Interactive Discussions.	**Direct**: In class interactive questioning, quizzes, written exams **Indirect**: student survey
2.2	Develop the student's ability to solve and analyze problems in physics related to the topics covered by the course.	PLO2.2	Lectures, Tutorials, Seminars, and Interactive Discussions.	**Direct** : In class interactive questioning, quizzes, written exams **Indirect**: student survey
2.3	Communicate in a clear and concise manner when analyzing practical relevant problems and using IT for acquiring exact solutions and information.	PLO2.3	Lectures, Tutorials, Seminars, and Interactive Discussions.	**Direct**: In class interactive questioning, quizzes, written exams **Indirect**: student survey
3.0	**Values, autonomy, and responsibility: Upon completing the course students will be able to**			
3.1	Show the collaboration and inter-professionalism in class discussions or team works, as well as solve problems independently.	PLO3.3	Expository and Discovery, and Interactive Discussions.	Group assignments, discussion
3.2				
...				

C. Course Content:

No	List of Topics	Contact Hours
1.	Introduction to Electrostatics: 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, Formal solution of boundary-value problem, Green' functions, Electrostatic potential energy.	7.5
2.	Boundary–Value Problems in Electrostatics, I: Method of images, Point charge and a grounded conducting sphere, Point charge and a charged, insulated, conducting sphere, Point charge and a conducting sphere at fixed potential, conducting sphere in a uniform field, Method of inversion, Green's function for a sphere, Conducting sphere with hemispheres at different potentials, Orthogonal functions and expansions, Separation of variables in rectangular coordinates.	6
3	Boundary-Value Problems in Electrostatics, II: 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, Expansion of Green's functions in spherical coordinates, Use of spherical Grren's function expansion, Expansion of Green's functions in cylindrical coordinates.	10.5
4	Multipoles, Electrostatics of Macroscopic Media, Dielectric: Multipole expansion, Multipole expansion of the energy of a charge distribution in an external field, Macroscopic electrostatics, Simple dielectrics and boundary conditions, Boundary–value problems with dielectrics, Molecular polarizability and electric susceptibility, Models for molecular polarizability, Electrostatic energy in dielectric media.	7.5
5	Magnetostatics: Introduction and definitions, Biot and Savart law, Differential equations of Magnetostatics, Ampere's law, Vector potential, Magnetic induction of a circular loop of currents, Localized current distribution, magnetic moment, Force, and torque on localized currents in an external field, Macroscopic equations, Boundary conditions, uniformly magnetized sphere in an external field, Permanent magnets, Magnetic shielding.	9
6	Time-Varying Fields, Maxwell's Equations, Conservations Laws: Faraday's law of induction, Energy in the magnetic field, Maxwell's displacement current, Maxwell's equations, Vector and scalar potentials, wave equations, Gauge transformations, Green's function for the time dependent wave equation, Initial-value problem, Kirchhoff's integral representation, Poynting's theorem, Conservation laws, Macroscopic equations.	4.5
Total		45

D. Students Assessment Activities:

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Homework #1, Discussions	2 st	5
2.	Homework #2	3rd	5
3.	Homework #3	5th	5
4.	First Mid Exam	6th	10
5.	Homework #4	7th	5
6.	Homework #5	10th	5
7.	Homework #6	11th	5
8.	second Mid Exam	12th	10
9.	Final Exam	16th	50

*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	J.D. Jackson, Classical electrodynamics, 3rd Edition, John Wiley and Sons, 1999.
Supportive References	W. Greiner , Classical Electrodynamics, Springer-Verlag New York, Inc., 1998. D. J. Griffith, Introduction to Electrodynamics, 4th Edition, Prentice Hall, 2013
Electronic Materials	
Other Learning Materials	

2. Educational and Research Facilities and Equipment Required:

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	The classroom should be facilitated with practical and multiple whiteboards.
Technology equipment (Projector, smart board, software)	Projector and some software for numerical calculations must be available for students.
Other equipment (Depending on the nature of the specialty)	None

F. Assessment of Course Quality:

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students, Peer and program leader	Indirect (CES)- Indirect peer evaluation
Effectiveness of students assessment	Students, Program assessment committee	Direct/ Indirect
Quality of learning resources	Students, Faculty members	Indirect
The extent to which CLOs have been achieved	Instructor	Direct/Indirect
Other		

Assessor (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval Data:

COUNCIL /COMMITTEE	**Department Council**
REFERENCE NO.	**Psci2415**
DATE	**1/10/2024**