Lahore University of Management Sciences

PHY 501/EE 502 – Electrodynamics

Fall 2023

To understand how to navigate course outlines, consult: How to Use a Course Outline (http://surl.li/gpvuw)

Instructor	Rizwan Khalid
Room No.	9-113A
Office Hours	I will announce some specific hours when I will exclusively be in the office for this course. On most other days, an email appointment will be appreciated.
Email	rizwan_khalid@lums.edu.pk
Telephone	042-3560-8361
Secretary/TA	TBD
TA Office Hours	N/A
Course URL	On LMS
Support Services	LUMS offers a range of academic and other services to support students. These are mentioned below, and you are encouraged to use these in addition to in-class assistance from course staff. For a complete list of campus support services available for you click here (https://advising.lums.edu.pk/#supportservices)

Course Basics				
Credit Hours	3			
Lecture(s)	Nbr of Lec(s) Per Week	2	Duration	75 mins
Tutorial (bi-weekly)	Nbr of Lec(s) Per 2 Weeks	1	Duration	75 mins

Course Distribution	
Core	MS Physics
Elective	EE Grad and Physics PhD
Open for Student Category	All except BS Physics majors
Close for Student Category	BS Physics majors

COURSE DESCRIPTION

This is an introductory course on electrodynamics and serves to fill the gaps in the education of the typical graduate student in the Physics department. The course aims to deliver the concepts of electromagnetism in a mathematically rigorous fashion. A primary goal is the mathematical maturity of our graduate students with particular focus on vector calculus, the underlying basis of Sturm-Liouville theory and the use of the same in solving linear partial differential equations via separation of variables. We begin with electrostatic and magnetostatic phenomena in the first eight weeks of the course and finish off by discussing electromagnetic induction, propagation of plane waves in free space as well as reflection and refraction on plane boundaries as well as a bit of radiation.

COURSE PREREQUISITE(S)

None. The course assumes a nodding acquaintance with linear ordinary differential equations and linear algebra. Also, the course assumes students do understand the basics of electrodynamics.

	Learning Outcomes (CLOs)	Cognitive Level
1	Analyze problems in electrostatics and magnetostatics.	Analysis
2	Analyze time-dependent electric and magnetic fields and the waves resulting from the same in free space, dielectrics and planar interfaces.	Analysis
3	Analyze the electromagnetic radiation from a localized source distribution.	Analysis

Grading break up: Component Details and weightages

Lahore University of Management Sciences

Assignments (15%): 5-7. The assignments shall be done in groups of 2 students each. A generous N-X policy shall be implemented.
Assignments will normally be handed out on Wednesdays/Thursdays and will be due the following week on Friday at 5pm. Late submissions will be acceptable within two days albeit with a 20% penalty.

Quizzes (15%): Weeks 5, 13. Quiz 1 tests material taught in the first four weeks, Quiz 2 tests material taught in Weeks 10-12. The quizzes are to be held in 75 minute sessions arranged at mutually agreeable times. An N-1 will be implemented.

Mid Term (25%): A 75 minute Mid-term exam shall be held in Week 9. It will include all of electrostatics and magnetostatics.

Attendance (**5%**): In order to be marked present, you must be in the classroom before the start of the class.

Final Exam (40%): Three hour comprehensive final exam on date given by the RO.

Grading Basis (Relative)
You will be graded on a normal curve.

Examination Detail	
Midterm Exam	Yes: Oral exam Separate: Duration: 75 minutes Preferred Date: Week 9 Exam Specifications: Based on electrostatics and magnetostatics (CLO1)
Final Exam	Yes/No: Yes Combine/Separate: Combined Duration: 3 hours Exam Specifications: Comprehensive final exam.

Campus supports & Key university policies

Campus Supports

Students are strongly encouraged to meet course instructors and TA's during office hours for assistance in course-content, understand the course's expectations from enrolled students, etc. Beyond the course, students are also encouraged to use a variety of other resources. (Instructors are also encouraged to refer students to these resources when needed.) These resources include Counseling and Psychological Services/CAPS (for mental health), LUMS Medical Center/LMC (for physical health), Office of Accessibility & Inclusion/ OAI (for long-term disabilities), advising staff dedicated to supporting and guiding students in each school, online resources (https://advising.lums.edu.pk/advising-resources), etc. To view all support services, their specific role as well as contact information click here (https://advising.lums.edu.pk/#supportservices).

Academic Honesty/Plagiarism

LUMS has zero tolerance for academic dishonesty. Students are responsible for upholding academic integrity. If unsure, refer to the student handbook and consult with instructors/teaching assistants. To check for plagiarism before essay submission, use similarity@lums.edu.pk. Consult the following resources: 1) Academic and Intellectual Integrity (http://surl.li/gpvwb), and 2) Understanding and Avoiding Plagiarism (http://surl.li/gpvwo).

LUMS Academic Accommodations/ Petitions policy

Long-term medical conditions are accommodated through the Office of Accessibility & Inclusion (OAI). Short-term emergencies that impact studies are either handled by the course instructor or Student Support Services (SSS). For more information, please see Missed Instrument or 'Petition' FAQs for students and faculty (https://rb.gy/8sj1h)

LUMS Sexual Harassment Policy

LUMS and this class are a harassment-free zone. No behavior that makes someone uncomfortable or negatively impacts the class or individual's potential will be tolerated.

To report sexual harassment experienced or observed in class, please contact me. For further support or to file a complaint, contact OAI at

Course Overview		
Week#	Topics	CLOs
1,2	Introduction, vector calculus, electric field and potential, Gauss's law	CLO1
3-5	Orthogonal functions, Uniqueness theorem, solutions to electrostatic boundary value problems by using images, separation of variables, multipole expansion, dielectrics	CLO1
6-7	Magnetostatics	CLO1
8	Displacement current, electromagnetic induction,	CLO2
9	Mid-term week, No class.	
10-11	Poynting's theorem, plane waves in free space, polarization	CLO2
12	Reflection and refraction of plane waves	CLO2
13-14	Retarded potentials, dipole radiation	CLO3

Textbook(s)/Supplementary Readings	
1	**Introduction to Electrodynamics, 4th ed, David J Griffiths (DJG), Pearson 2013**. Griffiths is the most popular treatment of electrodynamics for the undergraduate student. This course will be mostly based on Griffiths but we will supplement it fairly regularly with other sources.
2	**Classical Electrodynamics, 3rd ed, John D Jackson (JDJ), John Wiley 1999.** This is considered the gold standard for graduate level electrodynamics and is perhaps the most widely used book on the subject. It is concise and is generally very well written. The well-prepared student should plan to read this book.
3	**Mathematics of Classical and Quantum Physics, FW Byron and RW Fuller, Dover Publications 2012**. The primary purpose of this book is to treat the mathematical concepts more rigorously.
4	**Electricity and Magnetism, MH Nayfeh and MK Brussel, Dover Publications 2015.** A book with solved problems and plenty of exercises.
5	**Classical Electrodynamics, W Greiner and DA Bromley, Springer 2012.** The Greiner series is known for its rigor as well as being a treasure trove of solved problems.

Course Policies	
Late Assignment	20% penalty for submissions that are up to two days late. Assignments not accepted thereafter.
Missed Assignment	Missed assignments shall be catered to by the N-X policy.
Missed Quiz/Exam	Please petition the SSS in case of a missed quiz/assignment.

Course Readings: Refer to Textbook list above for color coding. [This section will be constantly updated during the course, ensuring that the reading list for the following week is always accessible to you.]		
Lec #	Topics	Readings
1	Coordinate systems (rectangular, spherical and cylindrical), Scalars and vectors, Scalar and vector fields, Differentiation of a vector, Line integral and the gradient of a scalar field.	1.1-1.5, 1.7; 1.1-1.2, 1.4
2	Surface and volume integrals, Divergence and curl of a vector field. Cartaesian tensors.	1.7-1.8; 1.3-1.4
3	Maxwell's equations in free space, linearity and superposition, conservation of electric charge, The Dirac delta function and the divergence of E	1.5, 2.1-2.2; 1.1-1.2
4	Gauss's law, the curl of E, electric potential	2.2-2.3; 1.3-1.5
5	Boundary conditions, Work and energy in electrostatics, Conductors in electrostatic equilibrium	2.3-2.5; 1.6, 1.11
6	Uniqueness theorem for electrostatic boundary value problems, the method of images	3.1-3.2; 1.7-1.9, 2.1-2.5