Lahore University of Management Sciences

EE330/PHY 305: Electromagnetic Fields and Waves

Fall 2023

Course Catalog Description
This course extends the concepts of static electric and magnetic fields to time-varying fields that give rise to electromagnetic waves. A brief overview of Vector Calculus, Electrostatics, and Magnetostatics will be given at the beginning leading to Maxwell's equations and their mathematical formulation describing the Electromagnetic wave phenomenon. Transmission lines are introduced as guiding structures for the propagation of electromagnetic waves. The propagation of electromagnetic waves through different media types and their behavior at interfaces will be explored. Wave propagation in various applications, such as waveguides, will also be discussed.

COURSE OBJECTIVES
A thorough understanding of Electromagnetic waves is crucial for developing a wide range of practical electrical engineering systems, including telecommunication networks, high-speed electronics, and photonics systems. This course will cover core concepts of electromagnetic wave theory, emphasizing transmission lines and propagation of plane electromagnetic waves in various media. Each covered concept will be augmented with discussions on industrial and research applications.

Course Details	
Credit Hours	3
Core	Core Course for Electrical Engineering
Elective	
Open for Student Category	Junior / Senior
Closed for Student Category	Freshman / Sophomore

Course Prerequisite(s)/Co-Requisite(s)
MATH 102: Calculus-II (Required) PHY 204 Electricity and Magnetism (Required)

Course Offering Details						
Lecture(s)	Nbr of Lec(s) Per Week	2	Duration	75 min	Timings and Venue	MW: 2:30-3:45 pm,
Tutorials	Nbr of Tut(s) Per Semester	6-8	Duration	60 min	Timings and Venue	TBA

Instructor	Imran Cheema
Room No.	9-252A
Office Hours	TBA
Email	imran.cheema@lums.edu.pk
Telephone	x8467
Secretary/TA	TBA
TA Office Hours	TBA
Course URL (if any)	LMS. Fall 2020 lectures playlist: https://youtube.com/playlist?list=PLvc6lm5tDTeXrHgQf2CFPM4wO64UAi7pe

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Course Learning Outcomes	
	The students should be able to:
CLO 1	CLO 1: Analyze transmission lines in the frequency and time domains.
CLO 2	CLO 2: Carry out the transformation between integral and differential forms of Maxwell's equations and solve them for 1D electromagnetic problems
CLO 3	CLO 3: Analyze uniform plane wave propagation in various media, including free space, dielectrics, conductors, and waveguides.

Relation to EE Program Outcomes

EE-330 CLOs	Related PLOs	Levels of Learning	Teaching Methods	CLO Attainment checked in
CLO1	PLO2	Cog-4	Instruction, Tutorial, Quizzes, Assignments	Assignments, Quizzes, Midterm, Final
CLO2	PLO1	Cog-3	Instruction, Tutorial, Quizzes, Assignments	Assignments, Quizzes, Midterm, Final
CLO3	PLO2	Cog-4	Instruction, Tutorial, Quizzes, Assignments	Assignments, Quizzes, Final

Grading Breakup and Policy

Assignments (6-8): 8%
Complex Engineering Problem:2%
Quizzes (5-7): 20%
Class Participation: 8% (tentative)
Midterm Examination: 27%
Final Examination: 35%

Examination Detail

Yes/No: Yes
Combine/Separate: Combine
Duration: 2-3 hrs.
Exam Specifications: Closed book, closed notes. A cheat sheet is allowed.

Yes/No: Yes
Combine/Separate: Combine
Duration: 3 hrs.
Exam Specifications: Closed book, closed notes. A cheat sheet is allowed.

Academic Honesty

The principles of truth and honesty are recognized as fundamental to a community of teachers and students. This means that all academic work will be done by the student to whom it is assigned without unauthorized aid of any kind. Plagiarism, cheating, and other forms of academic dishonesty are prohibited. Any instances of academic dishonesty in this course (intentional or unintentional) will be dealt with swiftly and severely. Potential penalties include receiving a failing grade on the assignment in question or in the course overall. For further information, students should make themselves familiar with the relevant section of the LUMS student handbook.

Harassment Policy

SSE, LUMS, and particularly this class, is a harassment-free zone. There is absolutely zero tolerance for any behavior that is intended or has the expected result of making anyone uncomfortable and negatively impacts the class environment or any individual's ability to work to the best of their potential. In case a differently-abled student requires accommodations for fully participating in the course, students are advised to contact the instructor so that they can be facilitated accordingly. If you think that you may be a victim of harassment, or if you have observed any harassment occurring in the purview of this class, please reach out and speak to me. If you are a victim, I strongly encourage you to reach out to the Office of Accessibility and Inclusion at oai@lums.edu.pk or the sexual harassment inquiry committee at harassment@lums.edu.pk for any

queries clarifications, or advice. You may choose to file an informal or a formal complaint to put an end to offending behavior. You can find more details regarding the LUMS sexual harassment policy here. To file a complaint, please write to harassment@lums.edu.pk.

SSE Council on Equity and Belonging

In addition to LUMS resources, SSE's **Council on Belonging and Equity** is committed to devising ways to provide a safe, inclusive, and respectful learning environment for students, faculty, and staff. To seek counsel related to any issues, please feel free to approach either a member of the council or email at cbe.sse@lums.edu.pk

Rights and Code of Conduct for Online Teaching

Misuse of online modes of communication is unacceptable. TAs and faculty will seek consent before the recording of live online lectures or tutorials. Please ensure if you do not wish to be recorded during a session to inform the faculty member. Please also ensure that you prioritize formal means of communication (email, lms) over informal means to communicate with course staff.

Textbook(s)/Supplementary Readings

Textbook:
Introduction to Electromagnetic Fields (3rd Edition) by Clayton R. Paul, Keith W. Whites, Syed A. Nasar
Reference books:
Engineering Electromagnetics (8th Edition) by William H. Hayt and John A. Buck

Complex Engineering Problem/Activity:	
Complex Engineering Problem Details	Included: Yes Nature and details of Complex Engineering Problem: The students will be given an electromagnetic wave propagation problem involving designing and analyzing an engineering system. The problem will test students in the required depth of knowledge (WP1), range of conflicting requirements (WP2), and depth of analysis required (WP3). Assessment in: Assignment
Complex Engineering Activity Details	Included: No Nature and details of Complex Engineering Activity: N/A Assessment in: N/A

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EE330/PHY305 Fall 2023 (Detailed Tentative Agenda)

Date	Day	Class	Main topic	Events	Readings	Deliverables
4-Sep	M	1	Course Introduction & Motivation		Chapter 1	
6-Sep	W	2	Transmission lines physical description and equations		10.1,10.2, 10.3 (H)	
11-Sep	M	3	Sinusoidal waves on Transmission lines		10.4,10.5,10.6(H)	
13-Sep	W	4	Low-Loss Transmission Lines, Power Transmission, Wave Reflection at Discontinuties		10.7,10.8,10.9 (H)	
18-Sep	M	5	VSWR, Finite length Transmission lines	**Tutorial 1**	10.10,10.11 (H)	Assignment 1(TL)
20-Sep	W	6	Transmission line examples, Transient Analysis	**Quiz 1 (classes 1-5)**	10.12, 10.14 (H), 7.2	
25-Sep	M	7	Transmission Lines' Transient Analysis		10.14 (H), 7.2	
27-Sep	W	8	Vector Calculus: Review	**Tutorial 2**	Chapter 2	Assignment 2 (TL)
2-Oct	M	9	Vector Calculus: Review		Chapter 2	
4-Oct	W	10	Maxwell's Equations, Constituitive Relations		Chapter 5	
9-Oct	M	11	Maxwell's Equations, Constituitive Relations	**Tutorial 3**	Chapter 5	Assignment 3(VC/ME)
11-Oct	W	12	Boundary Conditions	**Quiz 2 (classes 6-10)**	5.7	
16-Oct	M	13	Boundary Conditions, Poynting Vector		5.8	
18-Oct	W	14	Sinusoidal Steady State	**Tutorial 4**	5.9	Assignment 4 (ME/BC/PV/SS)
21-Oct	**Sat**		**MID TERM (Covering first 14 classes) (10:30am-1:30pm, Venue TBD)**			
23-Oct	M	15	No Class mid-term compensation			
25-Oct	W	16	Wave Equation, Uniform Plane Waves (UPW)		6.1	
30-Oct	M	17	UPW in Lossless and Lossy Media		6.2	
1-Nov	W	18	UPW in Good Dielectrics & Conductors, Skin Depth		6.3. 6.4	
6-Nov	M	19	UPW in Good Dielectrics & Conductors, Skin Depth		6.3. 6.4	Assignment 5 (UPW)
8-Nov	W	20	Wave Polarization	**Tutorial 5**	6.5	
13-Nov	M	21	Normal Incidence of UPW (Coefficients and Fields)	**Quiz 3 (classes 15-18)**	6.7	
15-Nov	W	22	Normal Incidence of UPW (loss less/perfect conductors, multiple interfaces)		6.7	
20-Nov	M	23	Oblique Incidence of UPW	**Tutorial 6**	6.8	Assignment 6 (NI)
22-Nov	W	24	Oblique Incidence of UPW	**Quiz 4 (classes 19-22)**	6.9, 6.10	
27-Nov	M	25	Parallel Plate Waveguide		8.2	Assignment 7 (OI/RTL)
29-Nov	W	26	Parallel Plate Waveguide		8.2	
4-Dec	M		CEP DUE			
4-Dec	M	27	Rectangular Waveguides	**Tutorial 7**	8.3	
6-Dec	W	28	Rectangular Waveguides, Cavity Resonators, Introduction to Antennas	**Quiz 5 (classes 23-27)**	8.3, 8.4	Assignment 8 (WG)
21-Dec	Th		**FINAL EXAM Covering All the Material (8:00am-11:00am)**			