National University of Sciences & Technology (NUST)
School of Electrical Engineering and Computer Science (SEECS)
Department of Electrical Engineering

EE-241 Electromagnetic Field Theory

Course Code:	EE-241	**Semester:**	4th
Credit Hours:	3+0	**Prerequisite Codes:**	NIL
Instructor:	Dr. Salman Ghafoor	**Discipline:**	BEE
Office:	Room # B205, IAEC	**Telephone:**	051-9085-2560
Lecture Days:	Mon, Tue, Fri	**E-mail:**	salman.ghafoor@seecs.edu.pk
Class Room:	CR 13, 14, UG Block SEECS	**Consulting Hours:**	Through email first
Knowledge Group:	Telecom and Networks	**Updates on LMS:**	End of Week

Course Objectives:

The successful completion of course should lay down the required foundation for all subsequent courses in Telecommunication, especially in RF & Microwave engineering domain. Further, to understand the fundamental principles and laws of electromagnetism and the phenomenon of Wave propagation.

Course Learning Outcomes:

CLO	Description After the completion of the course the students will be able to:	BT Level	PLOs
1.	Describe the theories and concepts related to Electrostatics and Magnetostatics	C2	1
2.	Analyze the behavior of electric and magnetic fields at boundaries of different mediums	C4	2
3.	Describe application of Maxwell's Equations and phenomenon of Electromagnetic Wave Propagation	C2	1

Mapping of CLOs to Program Learning Outcomes

PLOs/CLOs	CLO1	CLO2	CLO3
PLO 1 (Engineering Knowledge)	√		√
PLO 2 (Problem Analysis)		√	
PLO 3 (Design/Development of Solutions)			
PLO 4 (Investigation)			
PLO 5 (Modern tool usage)			
PLO 6 (The Engineer and Society)			
PLO 7 (Environment and Sustainability)			
PLO 8 (Ethics)			
PLO 9 (Individual and Team Work)			
PLO 10 (Communication)			
PLO 11 (Project Management)			
PLO 12 (Lifelong Learning)			

Assessment Modules, Weightages, and Mapping to CLOs

Assessments/CLOs	CLO1	CLO2	CLO3
Quizzes: 10%	√	√	√
Assignments: 10%	√	√	√
OHTs: 30%	√	√	√
End Semester Exam:50%	√	√	√

Books:

Text Book:
- Elements of Electromagnetics by Matthew N.O.Sadiku, 3rd Edition

Reference Books:
- Engineering Electromagnetics by William H. Hayt, JR and John A. Buck, 7th Edition
- Introduction to Electrodynamics by Griffiths
- Engineering Electromagnetics by Nathan Ida,2nd Edition
- Engineering Electromagnetics by Kenneth and Demarest

Main Topics to be Covered:

- Vector Analysis: Vector Algebra, Coordinate Systems and Transformation, Vector Calculus
- Electrostatic Fields: Coulomb's Law, Gauss's Law, Electric Potential, An Electric Dipole, Maxwell's First equation
- Electric Fields in Material Space: Properties of Materials, Electric Current, Dielectrics, Boundary Conditions
- Poisson's and Laplace's equation: Derivation of Poisson's and Laplace's equations, Resistance and Capacitance
- Magnetostatics Fields: Biot-Savart's Law, Ampere's Circuit Law, Maxwell's Equation, Magnetic Potential
- Magnetic Forces, Materials and Devices: Magnetic Force, Magnetic Torque, A magnetic Dipole, Boundary Conditions, Inductors and Inductances, Magnetic Energy
- Maxwell's Equation and Wave Propagation: Faraday's Law, Motional EMFs, Displacement Current, Maxwell's Equations in Final Form, Time- Varying Potentials
- Plane Electromagnetic Waves: Uniform plane waves, phase and group velocity, wave impedance,
- dielectric and conducting media, polarization, energy and Poynting vector

No. of Weeks	Lecture No.	Topic
1st	1	Course Introduction, Vector Algebra
	2	Cartesian and Cylindrical Coordinates
	3	Spherical Coordinates
2nd	4	Vector Calculus - Integral of a Vector, Del, Gradient
	5	Vector Calculus – Divergence, Curl, Stokes' Theorem, Laplacian
	6	Coulomb's Law and Field Intensity
3rd	7	E-Field due to line charge distribution
	8	Problem Session
	9	E-Field due to Surface charge distribution
4th	10	E-Field due to Volume charge distribution
	11	Electric Flux Density and Gauss's Law
	12	Applications of Gauss's Law- Symmetry Arguments

5th	13	Problem Session
	14	Electric Potential and Potential Energy, Relationship between E & V
	15	An Electric Dipole, Energy Density in Electrostatics
6th	**ONE HOUR TEST (I)**	
7th	16	Problem Session
	17	Problem Session
	18	Convection and Conduction Currents, Conductors
8th	19	Polarization in Dielectrics, Dielectric Constant and Dielectric Strength
	20	Continuity Equation and Relaxation Time
	21	Dielectric-Dielectric Boundary Conditions
9th	22	Conductor-Dielectric Boundary Conditions, Linear, Isotropic and Homogeneous Dielectrics
	23	Problem Session
	24	Poisson's and Laplace's Equations, Resistance and Capacitance
10th	25	Problem Session
	26	Problem Session
	27	Magnetostatics - Biot-Savart's Law, Example 7.1 and Example 7.3
11th	28	Third Maxwell's Equation, Ampere's Law
	29	Ampere's Law, Magnetic Flux Density & Fourth Maxwell's Equation
	30	Problem Session
12th	**ONE HOUR TEST (II)**	
13th	31	Forces due to magnetic fields
	32	Problem Session
	33	Problem Session
14th	34	Magnetic Torque, Magnetization, Boundary Conditions
	35	Problem Session
	36	Problem Session
15th	37	Inductance, Magnetic Energy, Faraday's Law, Transformer and Motional EMFs, Displacement Current, Maxwell's Equations
	38	Electromagnetic Wave Equation
	39	Electromagnetic Wave Equation
16th	40	Transverse Electromagnetic Wave, x-oriented E-field
	41	Intrinsic Impedance
	42	Wave Propagation in a low-loss Dielectric
17th	43	Wave Propagation in a low-loss Dielectric, Loss Tangent
	44	Wave Propagation in a Good Conductor, Wave Velocity
	45	Power and the Poynting Vector
18th	46	Problem Session
	47	Problem Session
	48	Problem Session
19th	**FINAL EXAM**	

Grading Policy:

Quiz Policy: The quizzes will be a combination of announced and unannounced and normally last for ten minutes. The question framed is to test the concepts involved in last few lectures. Number of quizzes that will be used for evaluation is minimum 5. Grading for quizzes will be on a fixed scale of 0 to 10. A score of 10 indicates an exceptional attempt towards the answer and a score of 1 indicates your answer is entirely wrong but you made a reasonable effort towards the solution. Scores in between indicate very good (8-9), good (6-7), satisfactory (4-5), and poor (2-3) attempt. Failure to make a reasonable effort to answer a question scores a 0. There will be no 'best-of' policy.

Assignment Policy:	In order to develop comprehensive understanding of the subject, assignments will be given. Late assignments will not be accepted / graded. All assignments will count towards the total (No 'best-of' policy). The students are advised to do the assignment themselves. Copying of assignments is highly discouraged and violations will be dealt with severely by referring any occurrences to the disciplinary committee.
	SEECS maintains a zero tolerance policy towards plagiarism. While collaboration in this course is highly encouraged, you must ensure that you do not claim other people's work/ ideas as your own. Plagiarism occurs when the words, ideas, assertions, theories, figures, images, programming codes of others are presented as your own work. You must cite and acknowledge all sources of information in your assignments. Failing to comply with the SEECS plagiarism policy will lead to strict penalties including zero marks in assignments and referral to the academic coordination office for disciplinary action.
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