ELEC3600 Electromagnetics : From Wireless to Photonic Applications

Course Description

This area course introduces applied electromagnetics from fundamentals to applications. Topics include: Gauss', Faraday's and Ampere's laws; electrostatics and magnetostatics; Maxwell's equations; electromagnetic plane wave propagation; transmission lines; radiation and antenna fundamentals; light wave fundamentals. Students will also acquire hands-on experience to electromagnetics through laboratory sessions. *Prerequisite(s):* (MATH 2011 OR MATH 2023) AND MATH 2351 AND PHYS 1114

List of Topics

Week 1	Introduction, Vector algebra, Coordinate systems and transformations
Week 2	Vector calculus, Gradient, Divergence and Curl operators, Divergence's and Stoke's theorems, Vector fields
Week 3	Electrostatic Fields, Coulomb's Law, Gauss' Law, Electric Potential, Electrostatic Energy
Week 4	Electric Field in Material Space, Conductors and Dielectrics, Continuity Equation, Boundary Conditions
Week 5	Electrostatic Boundary Value Problem, Poisson's and Laplace Equations, Resistance and Capacitance
Week 6	Magnetostatic Fields, Bio-Savart's and Ampere's Laws, Magnetic Vector Potential
Week 7	Magnetic Forces, Materials and Devices, Magnetic Dipole, Magnetic materials, Magnetization, Magnetic Energy
Week 8	Maxwell's Equations, Displacement Current, Time-Harmonic Fields
Week 9	Electromagnetic Wave Propagation, Plane Waves, Poynting Vector, Reflection of plane waves at normal incidence, Standing waves
Week 10	Transmission Lines, Parameters and Equations, Input Impedance, Standing-wave ratio, Power, The Smith Chart, Transients on Transmission Lines
Week 11	Antennas, Dipole Antennas, Quarter Wave Monopole Antennas, Antenna Arrays
Week 12	Light wave fundamentals (optional topics to skip if time does not allow)

Laboratory Topic

1	Measuring magnetic fields
2	Polarization of light
3	Transmission lines

Statement of Objectives/Outcomes:

On successful completion of this course, students will be able to:

CO1 - solve the main problems of the electric and magnetic fields distribution for different device constructions, taking into account the boundary problems.

CO2 - be familiar with the Maxwell equations both in the integral and differential forms as the fundamental laws of the Electromagnetism and to give a physical evidence that lead to their appearance.

CO3 - present a basic description of the electromagnetic wave propagation in various materials, including conductors, dielectrics and magnetic materials.

CO4 - apply the basic principles of the electromagnetism to the development of the transfer devices of the electromagnetic energy, such as transmission lines and antennas.

Textbook(s):

Matthew N.O. Sadiku, *Elements of Electromagnetics*, 5th edition, Oxford University, 2011

Reference Book(s):

Liang Chi Shen / Jin Au Kong, Applied Electromagnetism, 3rd edition, Cengage Learning

Fawwaz T. Ulaby, *Applied Electromagnetics*, Pearson Education, Inc, Media Edition, 2004

N. N. Rao, *Elements of Engineering Electromagnetics*, 5th edition, Prentice Hall

Relationship of Course to Program Outcomes:

Please refer to the Report Section 4.3.2 (iii).

Grading Scheme:

Homework	15%
Lab	10%
Midterm Examination	30%
Final Examination	45%