ELE3102 Electromagnetic Fields

Period per Week			Contact Hour per Semester	Weighted Total Mark	Weighted Exam Mark	Weighted Continuous Assessment Mark	Credit Units
LH	PH	TH	CH	WTM	WEM	WCM	CU
45	30	00	60	100	60	40	4

Rationale

This course introduces students to the Basic laws electromagnetic fields and elementary applications of vector analysis, steady-state electric and magnetic fields, boundary value problems, and transmission lines.

Objectives

- To develop an understanding of electromagnetic-field fundamentals by emphasizing both mathematical analytical rigor and physical conceptual reasoning, as applied toward practical engineering problems.
- To develop the ability to analyze engineering systems based on electrostatic fields, steady electric currents, and magneto static fields in arbitrary material media,
- To apply vector calculus to solutions of a variety of static field problems
- To develop a solid grasp and an appreciation of Maxwell's equations and use these equations to solve time-varying field problems.

Course Content

1. Electromagnetic Potentials and Topics for Circuits and System

- Poisson's and Laplace equations
- Capacitance, conductance and inductance

- Magnetic circuits

2. ***Transmission-Lines Essentials***
   - Transmission lines
   - Lines terminated by reactive and non-linear resistive elements
3. ***Transmission Lines for Communications***
   - Different matching configurations
   - Smith Chart
   - Lossy Lines
4. ***Guided Wave Principles for Electronics and Optoelectronics***
   - Wave propagation in any direction
   - TE and TM waves in parallel plate waveguide
   - Dispersion and group velocity
   - Reflection and refraction
   - Dielectric waveguide
5. ***Waveguides and Antennas Fundamentals***
   - Rectangular Waveguides
   - Transverse Electromagnetic Waves (TEM)
   - Transverse Magnetic (TM) Modes
   - Transverse Electric (TE) Modes
   - Wave Propagation in the Guide
   - Power Transmission and Attenuation
   - Waveguide Current and Mode Excitation
   - Waveguide Resonators

Learning Outcomes

By the end of this course, students should be able to:

- Demonstrate a firm understanding of electromagnetic fields
- Solve realistic electromagnetic-field problems utilizing physical conceptual reasoning and mathematical synthesis of solutions, and not pure formulaic solving.

Recommended and Reference Books

[1] K. Lonngren, S. Savov, & R. Jost, *Fundamentals of Electromagnetics with MATLAB*, 2nd Edition (Scitech Publishing, 2007).

[2] R. Wolfson & J. Pasachoff, *Physics for Scientists and Engineers* (Addison-Wesley).

[3] J. Stewart, *Calculus*, Third Edition (Brooks/Cole Publishing Company, 1995).

[4] N. N. Rao, "*Elements of Engineering Electromagnetics*," 6th Edition, Prentice Hall, 2004.

[5] *Field and Waves in Communication Electronics*, third edition, Ramo, Whinnery, and Van Duzer, Wiley, 1994

[6] William H. Hayt, Jr. John A. Buck, 2000. *Engineering Electromagnetics*. 6th Edition MC Graw Hill.

[7] Mathew N.O. Sadiku, 2006. *Elements of Electromagnetics*, 4th Edition. ISBN 13: 9780195300482, ISBN 10:0195300483