**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