EENG 534 NUMERICAL METHODS IN ELECTROMAGNETICS

Department:
Electrical and Electronic Engineering

Program Name: Electrical and Electronic Engineering	**Program Code:** 21
Course Number: EE 534	**Credits:** 3

☐ Required Course ☒ Graduate Course

Prerequisite(s):
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Catalog Description:
Review of analytical and numerical methods for the field problems. Method of Moments applied to static field problems, scattering and antenna problems. Hallen's and Pocklinton's integral. The finite difference method for static and time-varying fields. Variational Medhods, the Rayleigh-Ritz method. The finite-element method. Absorbing boundary conditions.

Course Web Page:

Textbook(s):
Numerical Methods for Engineering by Karl F. WARNICK, SCITECH Publishing, Inc.

Indicative Basic Reading List :

1) M. N. O. Sadiku, *Numerical Techniques in Electromagnetics*, CRC Press, USA, 2000.
2) Taflove and S. C. Hagness, *Computational Electrodynamics:* The Finite-Difference Time-Domain Method, 2nd ed., Artech House: Boston, 2000.
3) D. M. Sullivan, *Electromagnetic Simulation Using The FDTD Method*, IEEE Press, USA, 2000.

Weekly Teaching Plan:

Week 1 Registration.

Week 2-3 Course objectives, course description.
Review of Electromagnetic Theory (6 Classes)
Time-varying fields, Maxwell's Equations, Electrostatic fields, Magnetostatic fields, Boundary Conditions, Wave Equations, Time-Harmonic Fields.

Week 4 **A review of basic numerical methods in electrodynamics. (3 Classes)**

Week 5-6 **Finite Difference Method (FD) (6 Classes)**
Finite Difference Schemes, Laplace's Equation, Finite Differencing of Laplace's Equation, Accuracy and Stability of FD Solutions, Practical Applications.

Week 7-9 **Finite Difference Time Domain Method (FDTD) (9 Classes)**
Yee's Finite Difference Algorithm, Accuracy and Stability, Lattice Truncation Conditions, Initial Fields, Programming Aspects, Absorbing Boundary Conditions (ABC) for FDTD, Applications.

Week 10-11 **Method of Moments (MoM) (6 Classes)**
Introduction, Integral Equations
Green's Functions, Applications ,Quasi Static Problems, Scattering Problems

Week 12-13 **Finite Element Method (6 Classes)**
Introduction, Solution of Laplace's Equation, Solution of Wave Equation.

Week 14-15 **Other Techniques (6 Classes)**
Calculus of Variation , Spectral Analysis

Course Objectives:

- Familiarize with the numerical techniques used in electromagnetics.
- Solve simple electromagnetic problems by using numerical techniques.

Course Learning Outcomes:

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

- understand the classification of EM problems,
- list and understand basic numerical methods in electrodynamics
- understand and apply the Finite Difference Method to closed region problems,
- understand and apply the Finite Difference Time Domain Method to open/closed region problems ,
- understand and apply the MoM ,
- understand and apply the Finite Element Method.
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Class Schedule:
3 hrs of lectures per week

	Method	No	Percentage
Assessment	Midterm Exam	1	35%
	Project	1	10%
	Homeworks	4-5	15%
	Final Examination	1	40%

Contribution of Course to Criterion 5

Credit Hours for:

Mathematics & Basic Science : 0
Engineering Design : 3
General Education : 0

Relationship of Course to Program Outcomes
The course has been designed to contribute to the following program outcomes:

(a) An ability to apply knowledge of mathematics, science, and engineering
(b) An ability to design and conduct experiments, as well as to analyze and interpret data
(c) An ability to design a system, component , or process to meet desired needs within realistic constraints
(e) An ability to identify , formulate and solve engineering problems
(i) A recognition of the need for, and an ability to engage in life-long learning
(k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Prepared by: Rasime Uyguroğlu | **Date Prepared:** 09 February 2015