ECE 5510: Introduction to Computational Electromagnetics

Course Description

Numerical methods for solving maxwell equations both static and electrodynamics, introduction to finite difference, finite element and integral equation methods, and applied linear algebra.

Prior Course Number: 715
Transcript Abbreviation: Int Comp Elctromag
Grading Plan: Letter Grade
Course Deliveries: Classroom
Course Levels: Undergrad, Graduate
Student Ranks: Senior, Masters, Doctoral
Course Offerings: Autumn
Flex Scheduled Course: Never
Course Frequency: Every Year
Course Length: 14 Week
Credits: 3.0
Repeatable: No
Time Distribution: 3.0 hr Lec
Expected out-of-class hours per week: 6.0
Graded Component: Lecture
Credit by Examination: No
Admission Condition: No
Off Campus: Never
Campus Locations: Columbus
Prerequisites and Co-requisites: Prereq: 3010. or Grad standing in Engineering, Biological Sciences, or Math and Physical Sciences.
Exclusions: Not open to students with credit for 715 or 813.
Cross-Listings:

Course Rationale: Existing course.

The course is required for this unit's degrees, majors, and/or minors: No
The course is a GEC: No
The course is an elective (for this or other units) or is a service course for other units: Yes

Subject/CIP Code: 14.1001
Subsidy Level: Doctoral Course

Programs

Abbreviation	Description
CpE	Computer Engineering
EE	Electrical Engineering

Course Goals

Learn the basics of finite difference methods for solving Maxwell equations, both static and electrodynamics
Learn the basics of finite element methods for solving Maxwell equations, both static and electrodynamics
Learn the basics of integral equation methods for solving Maxwell equations, both static and electrodynamics
Learn basics of applied linear algebra and graph theories for solving matrix equations, both sparse and dense, using direct methods

Learn basics of singular value decomposition (SVD) algorithm
Learn basics of Krylove based iterative matrix solution techniques for solving both sparse and dense matrix equations

Course Topics

Topic	Lec	Rec	Lab	Cli	IS	Sem	FE	Wor
Finite difference methods, Central/forward/backward differences, solving Poisson equations on a rectangular domain	6.0							
Finite difference time domain methods, stability analysis, dispersion analysis, simple first order absorbing boundary condition	6.0							
Finite element methods, bary-centric coordinate systems, Lagrange interpolation polynomials, applying FEM to solve Poisson equations, vector finite element basis functions	6.0							
Solving dielectric waveguides using vector finite element methods, modeling three dimensional inhomogeneous cavities, and application of vector finite element methods to 3D vector wave equations	5.0							
Integral equation methods for computing capacitances for multiple arbitrarily shaped conductors, numerical integrations for smooth and weakly singular kernels, RWG basis functions, EFIE, MFIE, CFIE	11.0							
Applied linear algebra for solving matrix equations, singular value decomposition (SVD) algorithm, graph theory for direct factorization and sparse direct matrix solvers, Krylov methods	8.0							

Representative Assignments

Homework
Computer Projects
Final Computer Project

Grades

Aspect	Percent
Homeworks	40%
Individual Computer Projects	40%
Final Team Computer Project & Report	20%

Representative Textbooks and Other Course Materials

Title	Author
Lecture Notes	

ABET-EAC Criterion 3 Outcomes

Course Contribution		College Outcome
***	a	An ability to apply knowledge of mathematics, science, and engineering.

Course Contribution		College Outcome
*	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.
	d	An ability to function on multi-disciplinary teams.
***	e	An ability to identify, formulate, and solve engineering problems.
	f	An understanding of professional and ethical responsibility.
*	g	An ability to communicate effectively.
	h	The broad education necessary to understand the impact of engineering solutions in a global and societal context.
**	i	A recognition of the need for, and an ability to engage in life-long learning.
	j	A knowledge of contemporary issues.
***	k	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Additional Notes or Comments

Updated abbreviation, prereqs, exclusions, goals and topics to match university format.

Change prereqs from 5010 and 5011 to 3010. 2/20/17 BLA

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