

EE 625 – Computational Electrodynamics

Spring 2012

Instructor: Dr. Stephen D. Gedney
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Office hours: Tues. 2 - 3 p.m., Th.. 2 - 3 p.m., or by appointment

Meeting Time: The course will meet T-Th from 8:00 – 9:15 am in Room 207 RGAN

EE625 URL: <http://www.engr.uky.edu/~gedney/courses/ee625>

Textbook: *The Method of Moments in Electromagnetics*, Walton C. Gibson, Chapman and Hall, CRC (ISBN-10: 1420061453).

Reference: *Computational Methods for Electromagnetics*, A. Peterson, S. Ray, and R. Mittra, IEEE Press, 1998.

Homeworks and will be assigned based on the lecture material and outside reading. The due date will vary with the length of each assignment. The homeworks and due dates will be posted on the course web page. All assignments are due at the *beginning* of the class period. You will be allowed one late assignment, which will be due the following class period. Otherwise, late assignments will not be accepted. Some homeworks will require computer simulations, which can be performed using mathematical software such as Matlab, MathCad, Maple, or Mathematica, or can be performed using a high-level programming language. Graphical results are expected to be computer generated and printed on a laser or ink-jet printer.

Paper Summary. A one page written summary of a journal paper will be due every second Thursday at the beginning of class (starting on 1/26 and excluding Spring break). You can pick any paper of interest to you and pertinent to this course published in a peer reviewed journal, such as the IEEE Transactions. The summary should be typed and should briefly summarize the main contribution of the paper.

Computer Projects There will be 4 computer projects assigned during the semester:

- 1) Scattering by a Dielectric Cylinder – SIE formulation
- 2) Scattering by a periodic strip grating
- 3) Scattering by a PEC Plate – Rooftop Basis
- 4) 3D Scattering: EFIE solution with the RWG Basis

The computer projects involve the development of high-level programs which can be performed in FORTRAN, C, or C++. Each project requires a brief report succinctly describing the theory, the numerical technique, and validating results. The functional program should be emailed to the instructor prior to the class period the program is due. One late project will be allowed, which is due the following class period. Else, late programs will lose 10 % credit per day late.

Final Project A final computer project will be due at the end of the semester. The topic of this project will be chosen near the beginning of April. The project will consist of developing a computer program to solve a problem agreed to by the instructor. A final report presenting the theory, numerical methods, and validating results will be handed in according to specified guidelines. A final presentation (15 minutes) of the project will be given during the final exam week. Attendance of all the presentations is mandatory.

Grading Scheme

	Homework	Computer Projects	Final Project
% of Final Grade	15 %	60 %	25 %

Final Grade Assessment: 90-100 A: 80-89 B: 70-79 C: 60-69 D: Below 60 E

Topical Outline

Lect	Date	Section	TOPIC
1	1/12	Notes	Maxwell's Equations, Vector Potentials, Duality, Poynting Theorem
2	1/17	Notes	Uniqueness, Reciprocity, Vector Green's Theorems
3	1/19	Notes	The Equivalence Principle
4	1/24	2.8	Dielectric Cylinder: SIE EFIE for TM polarization
5	1/26	2.8	Dielectric Cylinder: SIE MFIE for TE polarization
6	1/31	2.9	Impedance and Resistive Boundary Conditions (IBC and RBC)
7	2/2	2.9	Applications of Impedance Boundary Conditions
8	2/7	7.1-7.3	Periodic Functions and Floquet Harmonics (Project 1 due)
9	2/9	7.3	EFIE solution for scattering by strip grating
10	2/14	7.4	Accelerating the Green's function summation
11	2/16	10.1	3D Scattering by a plate: Rooftop Basis Functions and Razor Blade Testing
12	2/21	9.13	The RWG Basis function on triangles (Project 2 due)
13	2/23	9.13	The RWG Basis function on quadrilaterals
14	2/28	10.2	3D EFIE: RWG Basis, Razor Test
15	3/1	10.2	3D EFIE continued
16	3/6	Notes	Gauss-Quadrature Integration for a triangular domain/ Duffy Transform
17	3/8	Notes	The Khayat/Wilton Transform for singular integration (Project 3 due)
			Spring Break 3/12-3/17
18	3/20	Notes	3D MFIE with RWG Basis
19	3/22	Notes	3D EFIE – Galerkin Formulation – RWG
20	3/27	Notes	3D MFIE – Galerkin Formulation
21	3/29	9.14	RWG Basis in Curvilinear Coordinates
22	4/3	9.14	Curvilinear RWG Basis for Quadrilaterals
23	4/5	10.7	Scattering by a Homogeneous Dielectric Body – RWG Basis
24	4/10	Notes	The Nyström Method of Solution – Locally Corrected Nyström (Project 4 due)
25	4/12	Notes	LCN Solution with Quadrature Sampling
26	4/17	Notes	3D Scattering by PEC: LCN Formulation of EFIE
27	4/19	Notes	Continued
28	4/24	Notes	3D Scattering by PEC: LCN Formulation of MFIE
29	4/26	Notes	Applications of 3D LCN for 3D Scattering
	5/3		8:00 AM –(Thursday) Final Project Presentations – 259 FPAT