

EE 691-82 Applied EM- FDTD Method (3-0), SDSM&T, Spring 2012

Lecture Room & Time: TBD

Instructor: Dr. Thomas Montoya, EP325, Tel: 394-2459, e-mail: Thomas.Montoya@sdsmt.edu

Office Hours: 3-4 pm MWF, or by appointment.

WWW: See link from <http://montoya.sdsmt.edu>. The course web page will be heavily utilized for posting **assignments**, solutions, ... E-mail will be utilized to notify students of course-related information and events (**check daily**). Your first.last@Mines.sdsmt.edu address will be used.

Course Description: Fundamentals of using the finite-difference time-domain (FDTD) method for numerical modeling of applied electromagnetic problems.

Course Prerequisites: Permission of instructor

Text: *Computational Electrodynamics, The Finite-Difference Time-Domain Method* (Third Edition), Taflove and Hagness, 2005, Artech House, ISBN 1-58053-832-0.

Software: To implement the FDTD method, students are expected to be proficient in a programming language/tool (e.g., MATLAB, FORTRAN, C, ...).

Course Policies

- Course instruction will be delivered in lectures. Attendance is required. Notify instructor in advance (when possible) if you will be absent from class. Bring notes, text, and calculator to every class.
- Except when otherwise specified, all coursework is to be individually completed. Also, see the *Conduct* section in the catalog and the *Policy Governing Academic Integrity* for SDSM&T (link under <http://sdmines.sdsmt.edu/studentlife>).
- Students are encouraged to discuss coursework with classmates in general terms. However, copying, plagiarism, ... is not acceptable and will be penalized.
- Coursework assignments and completion dates will be announced and discussed as they come up during the semester. We will not have weekly scheduled laboratories.
- Missed coursework will **not** be made up. Coursework is due at the beginning of class on the specified days (up to 20% penalty for being late w/out doctor's note ...). Coursework will not be accepted after solutions are posted on web page. The lowest homework grade will be dropped (no questions asked). The drop is meant to cover any absences, i.e., illness, interviews, trips...
- To facilitate grading, all coursework shall meet the following specifications:
 - (a) Use the front side only of pages (i.e., single-sided).
 - (b) Write-out/paraphrase problem and **show all work** (understandable without outside materials?). Reference equations derived elsewhere (e.g., source, equation # and/or page #). Fundamental equations (e.g., Maxwell's equations, Ohm's Law, ...) are excluded from this requirement.
 - (c) Writing/figures/graphs must be legible → illegible = no credit.
 - (d) All work exceeding one page should be stapled - no paper clips, folded corners, or folders.
 - (e) Answers should be boxed/double underlined, in decimal format (if numbers), and the variables, values & units (if any) included. Use lead zeros for fractional answers, e.g., 0.4 **not** “.4”.
- To facilitate grading, homework shall also (see example at course web page):
 - (a) Use 8.5” × 11” engineering graph paper or plain white paper (**No** pages from spiral notebooks).
 - (b) At the top of **every** page should be the date, course number, HW #, problem number(s), your name, & page numbering (i.e., page x of y or x/y formats). Ensure problems & pages are in order.
 - (c) Work problems sequentially in a single vertical column with parts clearly labeled, e.g., a), b), ... Leave a space between consecutive parts of a problem, and draw a line across the page at the end of each problem if there is more than one. No more than two problems on any single page.

- Laboratories, papers, and projects shall also (unless otherwise specified)
 - (a) These should be typed/word processed on 8.5" × 11" plain white paper.
 - (b) General format: Cover page, Introduction, Body, Conclusions/Summary, References, and Appendices. Use 12 point Times New Roman font and 1.25/1.5 line spacing.
 - (c) **All** pages should be in order & numbered (i.e., page x of y or x/y formats), excludes cover page.
 - (d) Figures/graphs should be titled (at bottom), labeled (i.e., names / units on axes), and scaled (i.e., numbers on axes). Tables should be titled (at top). All **must** be discussed/referenced in the text.
 - (e) Computer program(s)/subroutine(s) should be placed in appendice(s) and referenced in the text.
 - (f) Computer programs and subroutines shall begin with a header comment block listing course # & title, project number & title, and your name followed by a variables list defining all significant quantities/variables. Code should be heavily annotated with comments describing what each program block is meant to accomplish.

Course Goals: The objective of this course is to introduce students to modeling electromagnetic problems using the finite-difference time-domain (FDTD) method.

Student Learning Outcomes:

Upon completion of this course, students should demonstrate the ability to:

1. Model simple transmission line circuit problems using the FDTD method.
2. Model simple electromagnetic problems using the FDTD method.
3. Implement analytical absorbing boundary conditions (ABCs) for open/unbounded problems.
4. Implement perfectly matched layer (PML) ABCs for open/unbounded problem geometries.
5. Implement subcell models for structures smaller than the standard FDTD spatial cell dimensions (e.g., thin-wires, thin sheets, slanted conductor boundaries, ...).

<u>Evaluation:</u> Laboratories/Paper(s)/Projects	75%
Homework	25%
Total	100%

ADA: Students with special needs or requiring special accommodations should contact the instructor and/or the campus ADA coordinator, Jolie McCoy, at 394-1924 at the earliest opportunity.

Freedom in learning: Under Board of Regents and University policy student academic performance may be evaluated solely on an academic basis, not on opinions or conduct in matters unrelated to academic standards. Students should be free to take reasoned exception to the data or views offered in any course of study and to reserve judgment about matters of opinion, but they are responsible for learning the content of any course of study for which they are enrolled. Students who believe that an academic evaluation reflects prejudiced or capricious consideration of student opinions or conduct unrelated to academic standards should contact the dean of the college which offers the class to initiate a review of the evaluation.

Electronic Devices Policy: Please turn off your cell phone before class starts. No text messaging in class. No headphones. If you wish to use a laptop in this class for purposes of note taking, that's great; however, you will be required to download DyKnow software and then join ENGL350 to activate. Any attempt to circumvent the DyKnow monitoring system will be considered a form of cheating and a breach of academic integrity. Note that according to "Policy Governing Academic Integrity" in the SDSM&T Undergraduate Catalog, the instructor of record for this course has discretion of how acts of academic dishonesty are penalized, subject to the appeal process, and that "Penalties may range from requiring the student to repeat the work in question to failure in the course" (72-73). No other use of any other electronic/computer media is allowed during class time.

Course Schedule: Parts of chapters 1-10 supplemented by instructor notes & relevant papers (e.g., journal articles). See attached table (subject to revision by instructor).

Tentative Course Schedule

Class	Date(s)	Topics	Reading/ Text
1	1/13	Electrodynamics Entering the 21st Century	Chap. 1
1/16		Holiday	
2	1/18	The One-Dimensional Scalar Wave Equation	Chap. 2
3	1/20		
4	1/23		
5	1/25		
6	1/27		
7	1/30	1D FDTD and Transmission Lines	Notes
8	2/1		
9	2/3		
10	2/6		
11	2/8		
12	2/10	Introduction to Maxwell's Equations and the Yee Algorithm	Chap. 3
13	2/13		
14	2/15		
15	2/17		
2/20			
16	2/22	Numerical Dispersion and Stability	Chap. 4
17	2/24		
18	2/27	Incident Wave Source Conditions	Chap. 5
19	2/29		
20	3/2	Analytical Absorbing Boundary Conditions	Chap. 6
3/5 – 3/9		Spring Break	
21	3/12		
22	3/14	Perfectly Matched Layer Absorbing Boundary Conditions	Chap. 7
23	3/16		
24	3/19		
25	3/21		
26	3/23		
27	3/26		
28	3/28	Near-to-Far-Field Transformation	Chap. 8
29	3/30		
30	4/2		
31	4/4	Dispersive, Nonlinear, and Gain Materials	Chap. 9
4/6 – 4/9		Holiday	
32	4/11		
33	4/13		
34	4/16	Local Subcell Models of Fine Geometrical Features	Chap. 10
35	4/18		
36	4/20		
37	4/23		
38	4/25		
39	4/27	Make-up, review, &/or final project time	
Final Exam- A final project will be assigned in lieu of a final exam.			