EE 382 Applied Electromagnetics (3-0), SDSM&T, Spring 2018

Lecture Room & Time: EP 254 MWF from 10-10:50am

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

Office Hours: 3-4 pm MWF, or when available (open door policy).

WWW: See link from http://montoya.sdsmt.edu. The course web page will be heavily utilized for posting **assignments**, examples, 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.

Catalog Description: (3-0) 3 credits. Maxwell's equations for time-varying electromagnetic phenomena are developed and applications including transmission lines, plane waves, and antennas are studied.

EE 382 Prerequisites: EE 381 (Electric and Magnetic Fields).

Text: *Elements of Electromagnetics* (Sixth Edition), Sadiku, Oxford, 2015, ISBN 978-0-19-932138-4.

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.
- Except when otherwise specified, all coursework is to be individually completed. See the *Cheating Academic Integrity Policy* and *Community Standards* links under the *Policies/Definitions* link of the catalog (http://ecatalog.sdsmt.edu/). Note that according to the *Cheating Academic Integrity Policy*, "The South Dakota Board of Regents has clearly defined those acts that constitute violations of academic integrity (BOR Policy 2:33 - Student Academic Misconduct and BOR Policy 3:4 - Student Code of Conduct). These acts include, but are not limited to cheating and plagiarism; full definitions are found in BOR 2:33 and BOR 3:4. These acts of dishonesty violate the ethical values the university works to instill in all members of the campus community. The instructor of record for each course is responsible for clarifying the academic integrity standards for that course within the course syllabus."
- Students are encouraged to discuss homework/labs with classmates in general terms. However, copying, plagiarism … is not acceptable and will be penalized.
- Homework (HW) is due at the beginning of class on the specified days (up to 20% penalty for being late w/out doctor's note, etc.). If you know that you will be missing a class, it may be turned in early. HW will **not** be accepted or graded after solutions are posted on the course web page.
- Bring notes, text, and calculator (capable of complex number & linear algebra operations) to every class. Most quizzes will be unannounced and require a calculator. Occasionally a quiz may be open book/notes (no borrowing).
- Missed quizzes will **not** be made up. If you know that you will be missing a class for a school-related activity (athletic travel, academic conference, etc.), you may stop by the day before and ask to take a quiz early (if available).
- If 2/3 of quizzes and 2/3 of HW are completed at a **passing** level, the lowest HW grade and lowest two quiz grades will be dropped (no questions asked). If not, **all** quizzes and HW will count (no drops). The drops are meant to cover any absences, including those due to illness, interviews, trips…
- To facilitate grading, homework shall meet the following specifications (see example at course web page):
  (a) Use the front side (i.e., single-sided) of 8.5" × 11" engineering graph paper or plain white paper (NO pages torn from spiral notebooks) for assignments.

(b) At the top of **each** page should be the date, course number, problem number(s), your name, and the page numbering (i.e., page *x* of *y* or *x*/*y* formats in the right hand corner). Ensure problems & pages are in order.

(c) All work exceeding one page should be stapled - no paper clips, folded corners, or folders.

(d) Write-out problem descriptions, copy/draw figures, and **show all** work so it can be understood without the text. No work (i.e., "magic" answer) $\rightarrow$ no credit.

(e) Reference equations derived in the text (e.g., equation number and/or page number). Fundamental equations (e.g., Maxwell's equations, Ohm's Law ...) are excluded from this requirement.

(f) Use notation as given in class and text, especially for vectors.

(g) Writing/figures/graphs must be legible/large enough to read $\rightarrow$ illegible = no credit.

(h) 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".

(i) Work problems sequentially in a **single** vertical column with subparts clearly labeled, e.g., a), b) ... Leave a space (e.g., 1/2") 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.

(j) **No** more than **two** problems on any single page.

Special Laboratory Project:

This course does not have an associated lab. However, there will be one/two special laboratory project(s) during the semester. The project(s) and the open lab hours will be announced during the semester. The special lab project work will be conducted in EEP 127. Lab work will be performed in groups of two students. Use a laboratory notebook for all of your laboratory work. One lab notebook per group is sufficient. Work exclusively in ink and line out mistakes with a ~~single~~ strikethrough so they are clearly legible. Number the front of every page in the upper right corner, and only use the front side of pages. The backs may be used as scratch paper. This project is required to complete the course. Late reports will be penalized with a 10% score reduction per calendar day.

Course Goals:

Students should be provided with the working knowledge of the fundamentals of electromagnetic phenomena as characterized by Maxwell's equations and as they apply to electrical engineering.

Student Learning Outcomes:

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

1. Use magnetic circuits for the calculation of basic magnetic field problems such as solenoids and transformers.
2. Use Faraday's law to calculate problems involving induced emf, such as time-varying magnetic fields, transformers, and moving circuits.
3. Understand the importance of displacement current and calculate displacement current in electromagnetics and electrical circuits in general.
4. For lossless and lossy transmission lines, calculate distributed parameters, i.e., *R*, *L*, *G*, and *C*, and dependent quantities, e.g., characteristic impedance, phase velocity, attenuation constant, and phase constant.
5. Solve time-domain (transient) problems for lossless transmission lines involving unit-step and pulse excitations, i.e., calculate reflection coefficients and determine voltages and currents versus time at fixed positions or versus position at a given time.

6. Solve frequency-domain lossless and lossy transmission line circuits calculating, e.g., input impedances, refection coefficients, VSWR, currents, voltages and powers.
7. Use Smith charts to calculate lossless transmission line quantities such as reflection coefficients, impedances, locations of voltage maxima and minima, and VSWR.
8. Solve lossless transmission line matching problems, e.g., single-stubs, quarter-wave matching sections, and resistive pads, using both analytical solutions and the Smith chart.
9. Calculate uniform plane wave equations/parameters for propagation through lossless and lossy media.
10. Calculate the Poynting vector and time average power flow for uniform plane waves in lossless / lossy media.
11. Determine the reflection and transmission of uniform plane waves normally incident on a material half space.
12. Apply and calculate fundamental antenna concepts, definitions, and quantities.
13. Analyze a simple Hertzian dipole antenna.
14. Apply and use the Friis transmission equation and the radar range equation.
15. Make basic transmission line measurements with RF and microwave test equipment.

Evaluation:

3 Hour Exams (15%/ea)	45%
Quizzes	15%
Homework	10%
Special Lab Project(s)	10%
Final Exam	20%
**Total ..... **	**100%**

Grading scale: 100 > A > 90, 89 > B > 80, 79 > C > 70, 69 > D > 60, F < 60.

ADA: Students with special needs or requiring special accommodations should contact the instructor, (Dr, Montoya at 394-2459) and/or the Director of Counseling and Disability Services, Ms. Megan Reder-Schopp, at megan.reder-schopp@sdsmt.edu or 394-6988 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 Provost and Vice President for Academic Affairs to initiate a review of the evaluation.

Electronic Devices Policy: Please mute/turn off your cell phone before class starts. No text messaging in class. No headphones. You may use a laptop/tablet in this class for purposes of note taking. No other use of any other electronic/computer media, **other than calculators**, is allowed during class time.

Topics/Course Schedule: parts of Chapters 8, 9, 10, 11 & 13, see attached schedule (subject to revision).

Tentative Course Schedule

Class	Date(s)	Topics	Text Sections
1	1/8	**Course introduction; Magnetic Forces, Materials, and Devices-** Magnetic Circuits (Dr. Whites lectures 1 & 2)	8.10
2	1/10		8.10
3	1/12	**Maxwell's Equations-** Intro, Faraday's Law (Dr. Whites lecture 3)	9.1-9.2
1/15		**Holiday**	
4	1/17	transformer & motional EMFs, displacement current, summary of Maxwell's equations, time-varying potentials, and time-harmonic fields. Also, some discussion of non-ideal circuit elements, skin effect, and ideal transformers. (Dr. Whites lectures 4 - 10)	9.2-9.3
5	1/19		9.3
6	1/22		9.4
7	1/24		9.5
8	1/26		9.7, notes
9	1/29		9.3, notes
10	1/31	**Transmission Lines -** Intro, parameters, equations (lossy & lossless)	11.1-11.2
11	2/2		11.2-11.3
12	2/5		11.3-11.4
13	**2/7**	**Exam #1** (material from Chapters 8 , 9, & notes)	
14	2/9	Lossy transmission line equations cont., input impedance, SWR, and power	11.4
15	2/12		11.4
16	2/14	Lossless transmission lines- Smith charts, transmission line applications , matching (e.g., discrete components, qurter-wave transformers, single-stub)	11.5
17	2/16		11.5
2/19		**Holiday**	
18	2/21		11.5-11.6
19	2/23		11.6, notes
20	2/26		11.6, notes
21	2/28	Transients on lossless transmission lines (time-domain)	11.7
22	3/2		11.7
3/5 – 3/9		**Spring Break**	
23	3/12	Transients on lossless transmission lines (time-domain) cont.	11.7
24	3/14		11.7
25	**3/16**	**Exam #2** (Chapter 11 transmission line material through 11.6- frequency-domain)	
26	3/19	**Electromagnetic Wave Propagation-** Introduction, waves in general; plane waves in lossy & lossless dielectrics, free space, and conductors; power & Poynting vector	10.1-10.2
27	3/21		10.3
28	3/23		10.3-10.4
29	3/26		10.5-10.7
30	3/28		10.7-10.8
3/30		**Holiday**	
31	4/2	**Electromagnetic Wave Propagation cont.-** reflection/transmission of plane waves at normal incidence	10.8-10.9
32	4/4		10.9
33	4/6	**Antennas-** Introduction, Hertzian dipole	13.1-13.2
34	4/9		13.2
35	**4/11**	**Exam #3** (covers section 11.7 & Chapter 10 material)	
36	4/13	**Antennas cont.-** half-wave dipole, quarter-wave monopole, antenna characteristics	13.3-13.4
37	4/16		13.6
38	4/18		13.6
39	4/20		13.8-13.9
40	4/23	**Log-periodic dipole arrays (LPDA)** *if time allows*	Notes
41	4/25		Notes
42	4/27	**Make-up/review day**	
EE 382 Final Exam: 10-11:50am, Friday, May 4, 2018 EP 254			