EE 382/382L *Applied Electromagnetics*
Spring 2012

Instructor: Dr. Keith W. Whites
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Office hours: MWF 9-10 AM, M 11AM-12PM

Please use e-mail rather than the telephone if you need to contact the instructor. All e-mail will be answered. The instructor will have at least four office hours per week in which to answer any questions you may have on the lecture material, homework problems, laboratories, etc.

Catalog Description: (2.5-0.5) 3 credits. Pre-requisite: EE 381. Field theory (e.g., Maxwell's equations) for time-varying electromagnetic phenomena. Applications include transmission lines, plane waves, and antennas. Students are introduced to typical laboratory equipment associated with applied electromagnetics (e.g., vector network analyzer).

Meeting Times: The lecture portion of this course will meet Monday, Wednesday, and Friday from 10:00-10:50 PM in room EEP 208. The laboratory portion will meet at irregular times in room EEP 127.

Course Text: M. N. O. Sadiku, *Elements of Electromagnetics*, fifth edition. New York: Oxford University Press, 2010.

Grading: Two exams – 40 %
Final exam – 20 %
Homework – 25 %
Laboratories – 15 % (All labs must be completed for a passing grade in the course.)

Homework Policy: One homework set will generally be assigned each week, usually on Friday. The homework assignments will be distributed through the EE 382 web page accessible from the URL above. The homework is to be turned in at the beginning of class. Please write your name and student number on your homework and staple the pages together. Late homework will be penalized with a 10% score reduction per calendar day.

Exam Policy: The exams will be closed book, closed notes, and no formula sheets. Using or referring to equations stored in a calculator is not allowed, even if these equations came pre-programmed in the calculator. If you feel an exam problem was graded incorrectly, it must be resubmitted to the instructor within 24 hours from the time the exam was returned. Failure to write an exam will result in a score of zero. No makeup exams will be given. Upon prior notification of the instructor, allowances will be made under extreme circumstances.

Laboratories: This course does not have weekly scheduled laboratories. Laboratory assignments, completion dates, and open lab hours will be announced as they arise during the semester. The laboratories will be held in EEP 127 where microwave test equipment is located. Laboratory work will be performed in pairs of students. Use a laboratory notebook for all of your laboratory work. Only one laboratory notebook needs to be kept between a pair of students. Work exclusively in ink and cross out mistakes, keeping them legible. Number the front of every

page in the upper right corner. The first page of the lab book is to be used as the table of contents. Late laboratory reports will be penalized with a 10% score reduction per calendar day.

Honor System: All work written in the exams, homework, and the laboratories must be your own. Failure to abide by this rule will result, at a minimum, in a zero score for the assignment and/or further action following SDSMT regulations. Homework solutions and laboratories can be discussed with your colleagues that are currently enrolled in EE 382, but ***all work you submit must be your own***.

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

1. Apply Maxwell's equations to problems involving time-varying fields, particularly Faraday's Law.
2. Calculate distributed parameters (i.e., *R*, *L*, *G*, and *C*) and dependent quantities (e.g., characteristic impedance, phase velocity, attenuation constant, and phase constant) for simple lossy transmission lines.
3. Solve frequency-domain problems (e.g., find impedances, reflection coefficients, currents, voltages, and powers) for lossy transmission line circuits.
4. Solve time-domain (transient) problems (i.e., find reflection coefficients, currents and voltages versus time at stationary points **or** versus position at a given time) for lossless transmission lines.
5. Use Smith charts to calculate or find reflection coefficients, impedances, the location of voltage maxima and minima, and VSWR on a lossless transmission line.
6. Solve lossless transmission line matching problems (e.g., single-stub and quarter-wave matching sections).
7. Apply or calculate fundamental antenna concepts, definitions, or quantities.
8. Apply or use the Friis transmission and radar range equations.
9. Analyze and design a dipole/monopole or loop wire antenna.
10. Design, construct, match, and test a widely utilized antenna (e.g., LPDA).
11. Calculate uniform plane wave equations/parameters for propagation through lossy or lossless media.
12. Calculate the polarization of a uniform plane wave given the electric or magnetic fields.
13. Apply/calculate Poynting vector/theorem to uniform plane waves given the electric or magnetic fields.
14. Take measurements with modern microwave & RF test equipment.

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

Freedom in Learning Statement: Students are responsible for learning the content of any course of study in which they are enrolled. Under board of regents and university policy, student academic performance shall be evaluated solely on an academic basis and students should be free to take reasoned exception to the data or views offered in any course of study. Students who believe that an academic evaluation is unrelated to academic standards but is related instead to judgment of their personal opinion or conduct should contact the dean of the college which offers the class to initiate a review of the evaluation.

EE 382/382L Class Schedule
Spring 2012

Date	Text Section	Topic
1/13	8.10	Introduction to course. Pre-assessment. Magnetic circuits.
1/16	–	*No class.*
1/18	9.2	Faraday's law of induction. Lenz's law.
1/20	Notes	Faraday's law examples.
1/23	9.3	Faraday's law and moving circuits.
1/25	9.4	Displacement current and Ampère's law.
1/27	9.5	Maxwell's equations, boundary conditions.
1/30	9.7	Sinusoidal steady state, phasors.
2/1	Notes	Non-ideal behavior of physical circuit elements. Skin effect.
2/3	Notes, 9.3	Ideal transformer.
2/6	11.2, 11.3	Transmission lines and distributed l and c.
2/8	Notes, 11.7	Time domain solutions to TL wave equations.
2/10	Notes, 11.7	TL termination, reflections. Current waves.
2/13	–	Review.
2/15	–	**Exam #1**.
2/17	Notes, 11.7	Bounce diagrams.
2/20	–	*No class.*
2/22	Notes, 11.7	Pulse propagation on TLs. Time domain reflectometry.
2/24	11.3	Sinusoidal steady state excitation of lossless TLs.
2/27	11.4	Termination of TLs. Load reflection coefficient.
2/29	11.4	Input impedance of TLs. Excitation and source conditions.
3/2	11.4	Generalized reflection coefficient. Crank diagram. VSWR.
3/5	–	*No class.*
3/7	–	*No class.*
3/9	–	*No class.*
3/12	11.3	Lossy TLs. Dispersionless TLs. Special cases for general TLs.
3/14	11.5	Smith chart.
3/16	11.5	Smith chart (cont.).
3/19	Notes, 11.6	TL matching. Quarter-wave transformers. Resistive pads.
3/21	Notes	Single-stub tuner I – Analytical solution.
3/23	Notes, 11.6	Single-stub tuner II – Smith chart solution.
3/26	–	Review.
3/28	–	**Exam #2**.
3/30	Notes, 10.2	Uniform plane waves. Infinite current sheets.
4/2	10.3, 10.6	Uniform plane waves in lossy materials. Skin depth.
4/4	10.7	Poynting's theorem. Power flow and plane waves.
4/6	–	*No class.*
4/9	–	*No class.*
4/11	10.8	Uniform plane waves normally incident on a lossless half space.
4/13	Notes, 10.8	Example of a normally incident UPW on a lossless half space.
4/16	Notes	Electromagnetic radiation and antennas.
4/18	13.2	Hertzian dipole antenna.
4/20	Notes, 13.2	Near/far fields of the Hertzian dipole antenna. Radiation resistance.
4/23	13.6	Antenna radiation patterns. Directivity and gain.
4/25	13.8	Antenna effective aperture. Friis equation.
4/27	–	Review. Post-assessment.
4/30	–	**Final Exam**, 12:00-1:50 PM, Room EEP 208.