SYLLABUS – Fall 2011

ECE 351 Applied Electromagnetics	**MWF, 8:00-8:50 a.m. – ECE 125** **T 8:00-8:50 a.m. – ECE 125**

NOTE: **ECE 351 students have a required laboratory component as determined by the section in which they are registered. A separate laboratory schedule will be distributed.**

INSTRUCTOR	Ben Braaten, Assistant Professor, Department of Electrical and Computer Engineering, 101G E.E. Bldg., NDSU **e-mail**: Benjamin.Braaten@ndsu.edu **Voice**: (701) 231-7618. **Messages** through ECE Department office staff: (701) 231-7019. **FAX**: (701) 231-8677.	
	Campus Mail: Ben Braaten Electrical Engr. ECE Dept. NDSU Campus	**U.S. Mail**: Ben Braaten ECE Dept. NDSU Fargo, ND 58105-5285
COURSE DESCRIPTION	Lecture and laboratory introduction to electromagnetic waves in linear media, effects of boundaries, transmission lines, electrostatics, and magnetostatics. Introduction to time dependence and engineering applications.	
COURSE OBJECTIVES	In general the course objective is to develop student understanding of the use of vector calculus in the study and characterization of electromagnetic fields and waves, including application to transmission lines and radiowave propagation. This includes specific goals such as to develop student proficiency in the design and analysis of basic transmission line systems and to familiarize the student with an electromagnetic understanding of electric circuit components. The student should understand the basic principles for applying Maxwell's equations to problems in applied electromagnetics. This course is the basis for a lifelong study of this discipline.	
OFFICE HOURS	Office hours: **MWF 9:00-9:50a.m.** or ask for an appointment at another time. It's always a good idea to make an appointment so that I can contact you if I have a family emergency, etc.	
WEB SITE	As will be explained in class, you must be able to obtain course information from the Internet. The University provides extensive computing facilities for this purpose. Additional information about required Web resources will be available on my website: http://www.ndsu.edu/ece/people/faculty/braaten/index.html.	
E-MAIL	You must be able to receive email messages sent by your instructor to your NDSU email address and respond appropriately to such email messages.	
PREREQUISITES	**ECE 351 students must have successfully completed with a C or better the following courses: EE 206, Math 129, Math 165, Math 166, and Math 265. Students must also have completed Physics 251 and 252. Students must have completed ECE 311 and Math 266 with a C or better or be concurrently registered in ECE 311 and Math 266. If you don't meet these requirements,**	

	you must have permission from the ECE Department Chair. You must be familiar with vector calculus and Maxwell's equations and be willing to learn the additional mathematics that the instructor will introduce in the course. The instructor will also introduce concepts in electrical physics that might be in addition to or taught in a different manner from what you learned in your physics courses.
APPLIED ELECTRO-MAGNETICS AND OPTICS	ECE 351 provides the general background necessary or helpful for the following courses: ECE 411/611 Optics for Scientists and Engineers ECE 417/617 Optical Signal Transmission ECE 453/653 Signal Integrity ECE 455/655 Designing for Electromagnetic Compatibility ECE 751 Electromagnetic Theory & Applications ECE 755 Advanced Topics in Electromagnetics ENGR 780 (Advanced) Electromagnetic Theory ECE 351 is deliberately organized to give you the foundation to explore the areas represented by the above courses. Please consult the NDSU optics Web site for additional opportunities. http://www.ece.ndsu.nodak.edu/~drogers/Optics2004/index.htm
ACKNOWLEDGMENT	The instructor acknowledges his debt to Dr. Robert M. Nelson and Dr. David A. Rogers for the organization of this course and for permission to use their course materials.
DISABILITIES OR SPECIAL NEEDS	Any students with disabilities or other special needs who need special accommodations in this course are encouraged to share these concerns or requests with the instructor as soon as possible so that appropriate arrangements for those accommodations can be made.
INSTRUCTOR HELP	Your instructor has designated office hours and is happy to help students who are trying, but still are having difficulties. Questions in class are valuable to all concerned, so don't be bashful.
TEXTBOOK	W. H. Hayt, Jr. and J. A. Buck, *Engineering Electromagnetics*. McGraw Hill, Eigth Edition (2012). The publisher's URL for this book is: http://www.mhhe.com/haytbuck7 . Answers to some problems can be found in Appendix E of the textbook. Schaum's *Outline of Electromagnetics* is an optional reference for the course.
READING ASSIGNMENTS	This is a reading "budget" that will guide you through the first part of the textbook during the term. Be careful to stay on schedule.

HONESTY	All work in this course must be completed in a manner consistent with NDSU University Senate Policy, Section 335: Code of Academic Responsibility and Conduct, which is available on the Web at: http://www.ndsu.nodak.edu/policy/335.htm . Violation of this code will result in a penalty or penalties to be determined by the instructor to fit the gravity of the offense and the circumstances of the particular case. The instructor may: (1) fail the student for the particular assignment or test, (2) give the student a failing grade in the course, or (3) recommend that the student drop the course. As future engineers, please also consider the Preamble to the Engineering Code of Ethics from the National Society of Professional Engineers: "Engineering is an important and learned profession. As members of this profession, engineers are expected to exhibit the highest standards of honesty and integrity. Engineering has a direct and vital impact on the quality of life for all people. Accordingly, the services provided by engineers require honesty, impartiality, fairness, and equity, and must be dedicated to the protection of the public health, safety, and welfare. Engineers must perform under a standard of professional behavior that requires adherence to the highest principles of ethical conduct." See: http://www.nspe.org/Ethics/CodeofEthics/index.html . Also the CEA Honor Pledge : "On my honor I will not give nor receive unauthorized assistance in completing assignments and work submitted for review or assessment. Furthermore, I understand the requirements in the College of Engineering and Architecture Honor System and accept the responsibility I have to complete all my work with complete integrity."
PROBLEMS	If you solve a homework problem using a computer program such as Matlab, please submit a hardcopy of the program and solution with your homework solution. If you use a procedure or program for a programmable calculator, you must submit a brief description of the procedure or program used with an indication of the model of calculator employed. Problems are to be worked on 8 1/2" X 11" engineering paper, on ONE SIDE ONLY. Usually it is helpful to draw a diagram of the given data for the problem. UNDERLINE all answers. SHOW ALL WORK. Give all equations before substituting numerical values into them and ALWAYS give the UNITS involved. **Please do not put any personal identification numbers on your homework or exams.**
PROBLEM COLLECTION	Your instructor will indicate the method of collecting homework problems, either by a written statement or orally.
COOPERATIVE	In addition to traditional lectures, we might also have cooperative learning

LEARNING ACTIVITIES AND UNANNOUNCED QUIZZES	activities and occasional unannounced short quizzes. Quizzes and activities may involve the assigned reading or previous course work. Makeup work for such activities is possible at the discretion of the instructor, but is normally allowed only in the case of student illness or an equally serious reason.
ATTENDANCE	Your attendance in class contributes to your own learning. Your active participation and enthusiasm for the course helps your classmates learn as well and encourages your instructor to do his best in the course. Your daily attendance and participation are sincerely appreciated by your instructor. Try not to miss any class. Thank you!
ABSENCES	Credit will be given for all student work turned in late if due to a legitimate excuse and arranged for by the student. It is the STUDENT'S responsibility to contact the instructor and explain the circumstances. The student is responsible for all material discussed in class whether or not he or she was in class. The student should realize that material might be covered in class which is not discussed in the textbook or which may be discussed in a different manner than in the book. If you miss a lecture, it is your responsibility to obtain lecture notes from a classmate. The instructor does not loan out his lecture notes. Late homework or projects are not accepted in this class. The only exception is student illness or a family emergency. The instructor will specify the due date in such cases. Even in those cases the absolute final deadline possible for submission is the official time of the final examination. It is the student's responsibility to contact the instructor in such cases. If you are going to miss an examination because of illness or a family emergency, telephone your instructor before the exam or on the same day, if possible, to see about a makeup exam. If you are going to miss a scheduled quiz, test, or examination, for a good reason, telephone the instructor before the scheduled date or on the same day, if possible. If your absence is considered valid, a make-up will be scheduled.
COURSE GRADE	This course will consist of lectures, presentations, demonstrations, discussions, cooperative learning activities, and homework problems. Your grade will be based on the results of quizzes, tests, the final examination, unannounced quizzes, class participation, and a complete course notebook. The course grade will be determined on the following basis or as specified by the instructor in class. Grade determination: Examination No. 1 15% Examination No. 2 15% Examination No. 3 15% Final examination 25% Laboratory work 15% Homework or quizzes 15% *Total* 100% If this grading policy has to be changed for some reason, this will be announced before the end of the second week of class. If some element of the course has to be cancelled for some unforeseen reason, its percentage points will be redistributed in proportion to the percentages associated with the other course elements. If for some unforeseen reason the course ends early, the grade will be based on your results to date.

	Quizzes, tests, and the final examination will cover: (1) all material presented in class by the instructor or by his designated substitute(s) including all class activities such as lectures, demonstrations, cooperative learning activities, videotapes, slides, and so forth; (2) reading assignments in the textbook; (3) information available at assigned Web sites; (3) homework; and (4) assigned library reserve materials. Unscheduled graded class activities are considered to be part of the next quiz, test, or examination.
	Letter grade assignment will be determined at the end of the semester by the instructor based on the student's overall course percentage. The minimum percentage necessary for each letter grade is as follows: A (90.0%), B (80.0%), C (70.0%), and D (60.0%). An "F" is associated with percentages below 60.0%.
	NOTICE that your grade is determined by you. To learn how to solve problems in electromagnetics you must solve problems in electromagnetics. This requires a constant effort throughout the term in reading the textbook, attending all lectures, studying lecture notes, working out homework problems, and reviewing your homework and tests. You cannot learn this material by just attending class and studying the night before a test. A thorough understanding of the material discussed in this course will benefit you throughout your career. To achieve this, a constant effort throughout the semester in reading the textbook and working homework problems is required.
ECE DEPARTMENT LAB POLICY	In all ECE courses with laboratory work ▪ each student **must** perform each experiment, and ▪ each student **must** turn in a report for each experiment in order to receive a passing grade in the course.
ADDITIONAL HELP	If you have questions about the way a particular assignment or test was graded, do not hesitate to discuss this with your instructor. However, to keep grading as fair as possible, this must be done within a few days after the test or assignment was returned to you. NO CHANGES will be made after that time.
MATERIALS NEEDED	You will need a compass and straightedge for the graphical work that will be done in this course. Please use 8 1/2" by 11" engineering paper for your homework. If you are thinking of buying a new calculator, for future ECE courses you might find it useful to have one that uses complex numbers and complex hyperbolic functions directly and that inverts matrices of complex numbers.
ERRORS OR OMISSIONS	Please inform the instructor if you find errors in the syllabus or if you think an error was made in class. Your instructor is anxious to correct such mistakes. If necessary, a corrected syllabus will be distributed in class or posted on the Web.
ABET OUTCOMES ADDRESSED:	Specifically, the student will be able to: 1. Design a single-stub tuner (a,c,e,l). 2. Predict the effects of pulse transmission on a transmission line (a,e,l). 3. Calculate the component values for an equivalent circuit of a transmission line (a,e,l). 4. Measure the loss as a function of frequency of a passive microwave device

	(a,b,d,e,g,k). 5. Demonstrate the degradation of a passive discrete component at high frequencies (a,b,d,e,f,g,k,l). 6. Use vector calculus to predict electric and magnetic field values in components with symmetrical geometries (a,e,i,l). 7. Apply the boundary conditions in a problem involving an interface between media (a,e,l). 8. Predict future values of electromagnetic field quantities under time varying conditions (a,e,f,j,l). 9. Compute the electromagnetic interaction between various electrical devices found in industry (e,f,i,j,k). (a) an ability to apply knowledge of mathematics, science, and engineering (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 within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability (d) an ability to function on multidisciplinary 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, economic, environmental, and societal context (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Lecture	**Student Reading Assignments**	**Topics**
1	Look over pp. i-1 and the appendices.	Introduction to the course and overview of applied electromagnetics
2	301-311	Transmission lines
3	311-323	Transmission lines (cont.); pretest
4	456-460	Transmission line parameters
5	323-330	Transmission line examples
6	330-334	Transmission line examples (cont.)
7	334-341	The Smith Chart
8	342-345	Smith Chart examples
9		Smith Chart examples
10	345-353	Transients on transmission lines
11	354-358	Transients (cont.)
12		Review
13		Exam 1
14		Review and Lecture
15	p. 1-13	Vector analysis
16	13-22	Coordinate systems
17	26-41	Coulomb’s Law and the electric field

18	41-44	Stream lines
19	48-55	Gauss's Law for electric fields
20	56-60	Electric fields from charge distributions
21	61-70	Divergence
22	75-84	Energy and potential
23	84-89	Energy and potential examples
24	90-104	Potential gradient
25	109-118	Current
26		To be announced
27		To be announced
28	119-137	Boundary conditions
29	(124-126)	Method of images
30		To be announced
31		Review
32		Exam 2
33		Review and Lecture
34	143-154	Capacitance
35		Capacitance
36	154-159	Approximate methods and analogies **No More Tuesday Meetings**
37	160-162	Poisson's and Laplace's equations
38	162-172	Examples
39	180-188	Biot-Savart Law
40	188-207	Ampère's Circuital Law; curl
41	207-209	Magnetic flux
42		Review
43		Exam 3
44		Review and Lecture
45	210-223	Magnetic vector potential
46	230-252	Magnetic forces and materials
47	252-263	Boundary conditions
48	263-270	Inductance
49	277-284	Time-varying fields
50	284-288	Displacement current
51	288-296	General forms of Maxwell's equations
52	367-401	Plane waves and the skin effect
53		Advanced topics/Catch up
54		Advanced topics/Catch up
55		Catch up
56	All previous assignments	Final Examination 8:00 a.m. – 10:00 p.m., Tuesday, December 13th.