ECE 1259：Electromagnetics

FALL, 2024

INSTRUCTOR:	Yu-Sheng Lin
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OFFICE HOURS:	Wed.: 9:10 – 11:55 AM, Thu.: 9:10 – 11:55 AM or by appointment
LECTURES:	Wed.: 1:50 – 4:25 PM, Zone 3 - 106
EXTBOOK:	Roald K. Wangsness., Electromagnetic fields, New York: Wiley, 1979. ISBN: 0471041033.
TEACHING ASSISTANT:	Daoye Zheng
PREREQUISITE:	MATH 0240 - Analytic Geometry and Calculus 3; PHYS 0175 - Basic Physics, Science, and Engineering 2

DESCRIPTION:

Electromagnetic (EM) fields (or electromagnetic (EM) waves), as a form of energy, are the most important energy source in the world today. As a carrier of information transmission, EM wave has become an important means for human society to publish and obtain information and explore the unknown world. Basic technical course required for students majoring in electricity. It is essential knowledge for electrical engineers. EM wave is an important part of EM theory.

COURSE OBJECTIVES:

1. Use the constitutive properties of a material to determine the characteristics of a wave propagating in transverse electromagnetic mode.
2. Calculate the characteristic impedance and propagation constant for a wave propagating on a transmission line and use a Smith Chart to develop impedance matching networks.
3. Solve vector calculus problems in Cartesian, cylindrical and spherical coordinate systems, using base vectors in each.
4. Put to use Gauss's law and Faraday's Law to determine electric field, electric flux density and electric potential field for the static case.
5. Put to use Gauss's law for magnetic fields and Ampere's law to determine magnetic field and magnetic flux density for the static case.
6. Apply the concept of dynamic fields to each of the four Maxwell's equations to find voltages and currents in an electromagnetic system.

LEARNING OUTCOMES FOR THIS COURSE:

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics. Complex engineering problems include one or more of the following characteristics: involving wide-ranging or conflicting technical issues, having no obvious solution, addressing problems not encompassed by current standards and codes, involving diverse groups of stakeholders, including many component parts or sub-problems, involving multiple disciplines, or having significant consequences in a range of contexts.
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors. Engineering design is a process of devising a system, component, or process to meet desired needs and specifications within constraints. It is an iterative, creative, decision-making process in which the basic sciences, mathematics, and engineering sciences are applied to convert resources into solutions. Engineering design involves identifying opportunities, developing requirements, performing analysis and synthesis, generating multiple solutions, evaluating solutions against requirements, considering risks, and

making trade- offs, for the purpose of obtaining a high-quality solution under the given circumstances. For illustrative purposes only, examples of possible constraints include accessibility, aesthetics, codes, constructability, cost, ergonomics, extensibility, functionality, interoperability, legal considerations, maintainability, manufacturability, marketability, policy, regulations, schedule, standards, sustainability, or usability.

3. An ability to communicate effectively with a range of audiences
4. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives. A team consists of more than one person working toward a common goal and should include individuals of diverse backgrounds, skills, or perspectives.
5. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

GRADE DETERMINATION:

Homeworks	20%
Quizzes	20%
Midterm Exam	30%
Final Exam	30%

Letter grades will be determined from accumulated point totals and assigned according to the scale below.

A: 90 - 100	A-: 85 - 90	B+: 80 - 85	B: 76 - 80	B-: 73 - 76
C+: 70 - 73	C: 66 - 70	C-: 63 - 66	D: 60 - 63	F: < 60

Note: Up to 5% points could be granted to the final grade based on the overall course performance (lecture attendance, homework submission punctuality, course engagement such as in-class question answering and discussion, etc.).

EXAMS: There will be one midterm exam and one final exam. Exact exam dates will be announced at least two weeks ahead of time.

QUIZZES: In-class quizzes will be arranged generally prior to the exams. Each quiz will have up to a few questions or problems related to the learned content and help the preparation for exams. The lowest one quiz grade will be dropped when calculating final grades. Each student must complete the quizzes individually.

GRADE REBUTTAL: For any quiz or exam, you have one week to request correction if you feel your answer might be mis-graded. No correction will be made a week after the quiz or exam grade is posted.

HOMEWORK: Homework problems will be assigned throughout the semester. All finished homework needs to be submitted online by the specified due date. Homework will be graded and solutions for all homework problems will be posted 48 hours after the submission due date. The lowest one homework grade will be dropped when calculating final grades. While discussion between students is allowed for solving homework problems, each student must write and submit the homework individually.

ATTENDANCE: Less than 60% attendance might be failed for this course. Students will be given excused absences only in cases of a certified medical excuse, or a family emergency. Students missing homework because of an excused absence must submit the completed assignments after they return. Students missing an exam because of an excused absence will take the exam at another time arranged by the instructor.

MAKE-UP POLICY: Late homework submission will be accepted up to 48 hours after the initial due date with a 20% penalty, unless an extension request is approved **prior to the homework due date**. Extensions are granted at

the instructor's discretion. In general, **no** make-ups for quizzes and exams will be allowed. Exceptions will only be made for special circumstances such as a medical emergency. If you cannot attend a quiz or an exam, you must contact the instructor prior to the quiz and exam. Failure to do so will result in a zero grade on that quiz or exam.

MATERIAL COVERED: The sequence of the sections covered in this class is:

Week	**Contents**	**Descriptions**
1-2 (09/11)	Chapter 1	Vector analysis
3 (09/18)	Chapter 2	The basic law of electromagnetic field
4 (09/25)	Chapter 2	The basic law of electromagnetic field
5 (10/02)	Chapter 3	Static electromagnetic field and its solution to boundary value problem
6(10/09)	Chapter 3	Static electromagnetic field and its solution to boundary value problem
7 (10/16)	Chapter 3	Static electromagnetic field and its solution to boundary value problem
8 (10/23)		Mid-Term Exam
9 (10/30)	Chapter 4	Time-varying electromagnetic field
10 (11/06)	Chapter 5	Propagation of uniform plane waves in unbounded space
11 (11/13)	Chapter 5	Propagation of uniform plane waves in unbounded space
12 (11/20)	Chapter 6	Reflection and transmission of uniform plane waves
13 (11/27)	Chapter 6	Reflection and transmission of uniform plane waves
14 (12/04)	Chapter 7	Guided electromagnetic wave
15 (12/11)	Chapter 7	Guided electromagnetic wave
16 (12/18)	Chapter 8	Electromagnetic radiation
17 (12/25)		Final Exam Week