Syllabus

Course Information

Course Number: PHYS 207
Course Title: Electricity and Magnetism for Engineering and Science

Sections: 519 – 524
Lecture Time: MWF 9:20 – 10:10 am
Recitation Time: 519 M 11:00 am – 1:20 pm; 520 M 3:30 – 4:50 pm; 521 W 12:30 – 1:50 pm; 522 R 11 am – 12:20 pm; 523 R 5:00 pm – 6:20 pm
Location: Lecture – MPHY 205; Recitation – MPHY 336
Credit Hours: 3
Course Website: http://people.physics.tamu.edu/etanya/P208/P207.htm

Instructor Details

Instructor: Dr. Tatiana Erukhimova
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Office Hours: MW 1:30 – 3 pm by Zoom
https://tamu.zoom.us/j/99264734602?pwd=VXEySGRaZUhLSUs2TStSVGVIYlN0QT09
or by appointment
There will be weekly help sessions. Please check the website for updates.

Course Description

Calculus-based electricity and magnetism; electromagnetic phenomena; basic laws of electricity and magnetism; science and engineering problems involving charges, electromagnetic fields, and electrical circuits.

Course Prerequisites

Grade of C or better in PHYS 206; grade of C or better in MATH 152 or MATH 172 or equivalent; also taught at Galveston and Qatar campuses.

Special Course Designation

CORE

Course Learning Outcomes

Students will be able to

1. Define and calculate electric forces and electric fields for discrete and continuous charge distributions using Coulomb's Law while using Gauss's Law to analyze and solve for electric fields for symmetric charge distributions.
2. Define and calculate electric potential functions for discrete and continuous charge distributions.

3. Define and calculate magnetic fields and magnetic forces while using Ampere's Law to evaluate the magnetic fields created by currents.
4. Analyze circuits involving resistors, capacitors, inductors, batteries, and time-varying voltage sources by applying Faraday's Law of Induction for both time-independent and time-dependent circuits.
5. Define and derive displacement current in time-dependent circuits; formulate Maxwell's equations and recognize how Ampere's and Faraday's laws yield the wave equation which is the basis of Maxwell's Electromagnetic Theory of Light

Weekly Learning Outcomes

Week 1. Mechanics Review and Coulomb's Law

a. Calculate the potential energy function for various conservative forces in Cartesian coordinates
b. Calculate the potential energy function for gravity in polar coordinates
c. Calculate the Coulomb force exerted on a charged particle by a collection of charged particles, using Coulomb's Law and Superposition
d. Calculate the Coulomb force exerted on a charged particle by a continuous distribution of charge, using Coulomb's Law and Superposition

Week 2. Electric Forces and Fields

a. Define vector fields
b. Calculate the gravitational field from Newton's Law of gravity
c. Calculate the electric field produced by a point charge
d. Calculate the force on a charge due to a continuous distribution of charges
e. Calculate the electric field produced by various charge distributions

Week 3. Electric Potential Functions

a. Determine the electric potential function for simple electric fields in Cartesian coordinates
b. Determine the electric potential function due to a single charge
c. Determine the electric potential function due to a collection of charges
d. Determine the electric potential function due to a continuous distribution of charge

Week 4. Derivation of Gauss's Law

a. Define the area vector
b. Define solid angles and the total solid angle
c. Calculate electric flux for simple fields and surfaces
d. Calculate the contributions to flux for a single charge enclosed in an arbitrary surface
e. Calculate the contributions to flux for many charges, either inside or outside of an arbitrary surface.

Week 5. Applications of Gauss's Law and Capacitors

a. Determine the symmetry of the electric field for the three soluble geometries
b. Determine the appropriate Gaussian surface to evaluate the flux
c. Distinguish the difference between perfect insulators and perfect conductors
d. Determine the appropriate charge inside a Gaussian surface for these two cases
e. Combine the calculation of fields and potential functions to derive the capacitance of the three soluble systems
f. Analyze circuits with capacitors and batteries

Week 6. Current and Ohm's Law

a. Define current and obtain qualitative understanding of resistivity, resistance, and Ohm's Law
b. Obtain microscopic form of Ohm's Law in terms of current density vector
c. Derive drift velocity

Week 7. Simple, Time Independent Circuits
a. Obtain Kirchhoff's Laws from conservative nature of electric fields and conservation of charge
b. Analyze time independent circuits with batteries, capacitors and resistors

Week 8. Magnetic Fields
a. Examine phenomena leading to introduction of magnetic fields
b. Calculate the motion of charged particles in magnetic and electric fields
c. Find the magnetic force on a current carrying wire

Week 9. Ampere's Circuital Law
a. Apply Ampere's Principle to infinitely long thin wire
b. Apply Ampere's Principle to a current carrying loop
c. Evaluate magnetic flux through a surface
d. Verify Ampere's Circuital Law for simple paths
e. Apply the Circuital Law to simple situations, e.g. coaxial cable

Week 10. Induced EMF and Inductance
a. Analyze a demonstration of an induced EMF
b. Calculate the time derivative of magnetic flux for various situations
c. Demonstrate the non-conservative nature of the resulting electric field

Week 11. More Inductance and Simple Time Dependent Circuits
a. Analyze RL circuits
b. Analyze RC circuits
c. Analyze LC circuits

Week 12. Time Dependent Circuits
a. Analyze RLC Circuits with batteries
b. Analyze RLC circuits with time varying power supplies
c. Compare RLC circuits with forced, damped harmonic oscillator
d. Investigate the origin of resonances

Week 13. Maxwell's Equations
a. Analyze a charging capacitor to see the need for displacement currents
b. Demonstrate the resulting consistency of Ampere's Law with displacement currents included
c. Calculate the effect of including displacement current in conservation of charge equation
d. Obtain the differential form of Faraday's Law and Ampere's Law in vacuum

Week 14. Electromagnetic Waves
a. Obtain the wave equation from Maxwell's Equations
b. Demonstrate that sinusoidal electric and magnetic fields satisfy the wave equation
c. Calculate the resulting wavelength, frequency relations
d. Determine the velocity of propagation of the wave, the speed of light.

Textbook and/or Resource Materials

"Don't Panic: Volume II", by William H. Bassichis, 5th Edition

We will use clickers (REEF app) for various kinds of assessment: pop quizzes, homework quizzes, in class discussion, etc.

Supplemental Materials (previous years exams, problem solving videos):
https://classroom.physics.tamu.edu/

Grading Policy

- Mid-term exams 55%, Final exam 38%, Lecture quizzes 5%, and Recitation quizzes 2%
- Scale: 90-100 A, 80-89 B, 60-79 C, 45-59 D, <45 F. Grades may be curved upward.
- If your grade on the Final Exam is higher than your lowest grade on one of the three exams during the semester, the grade on the Final will replace that one lowest exam grade in computing the course grade (it will only replace one grade in case of two exams having the same lowest grade). The Final Exam grade cannot be used to replace an exam that has been missed without a University excused absence.

Late Work Policy

- The missed exam without a University excused absence will count as a zero when computing your final grade.

Course Schedule

Mid-term Exam Dates: Sept. 28, Oct. 26 and Nov. 23

Week	Topic	Learning Objectives
Aug. 30	Mechanics Review Coulomb's Law	Polar coordinates, potential functions Force between charged particles
Sept. 6	Electric Forces Electric Fields	Systems of particles Concept of a field
Sept. 13	Electric Potentials	Electric potential, voltage for systems of charges
Sept. 20	Gauss's Law Derivation	Derivation of Gauss's Law starting with Coulomb's Law
Sept. 27	Exam I (Sept. 28) Applications of Gauss Capacitors	Symmetric distributions, conductors and insulators, capacitance
Oct. 4	Current Ohm's Law	Definition of current, macroscopic and microscopic form of Ohm's Law
Oct. 11	Simple Circuits	Solution of time independent circuits with resistors, batteries and capacitors
Oct. 18	Magnetic Forces	Forces on charges and current carrying wires in magnetic fields

Oct. 25	EXAM II (Oct. 26) Magnetic Fields	Sources of magnetic fields, Ampere's Principle
Nov. 1	Ampere's Law	Derive and apply Ampere's Circuital Law
Nov. 8	Induced EMF Inductance	Define inductance. Induced electromotive force. Faraday's Law
Nov. 15	Time Dependent Circuits	Application of Faraday's Law to time dependent circuits
Nov. 22	Time Dependent Circuits EXAM III (Nov. 23)	Continue study of time dependent circuits
Nov. 29	Maxwell's Equations Waves	Introduce Maxwell's modification and obtain the wave equation. Speed of light
Dec.6	Review	Review
Dec. 13	FINAL EXAM	8:00-10:00 am

- It is your responsibility to determine what material is being covered each class and the dates of all exams
- Team work is encouraged outside of class but not on exams
- You should expect a quiz each class
- No calculators or notes are permitted on exams
- You should come to lecture having read about the topic and tried problems
- You should come to recitation with questions on problems

University Policies

Attendance Policy

The university views class attendance and participation as an individual student responsibility. Students are expected to attend class and to complete all assignments.

Please refer to Student Rule 7 in its entirety for information about excused absences, including definitions, and related documentation and timelines.

Makeup Work Policy

Students will be excused from attending class on the day of a graded activity or when attendance contributes to a student's grade, for the reasons stated in Student Rule 7, or other reason deemed appropriate by the instructor.

Please refer to Student Rule 7 in its entirety for information about makeup work, including definitions, and related documentation and timelines.

Absences related to Title IX of the Education Amendments of 1972 may necessitate a period of more than 30 days for make-up work, and the timeframe for make-up work should be agreed upon by the student and instructor" (Student Rule 7, Section 7.4.1).

"The instructor is under no obligation to provide an opportunity for the student to make up work missed because of an unexcused absence" (Student Rule 7, Section 7.4.2).

Students who request an excused absence are expected to uphold the Aggie Honor Code and Student Conduct Code. (See Student Rule 24.)

Academic Integrity Statement and Policy

"An Aggie does not lie, cheat or steal, or tolerate those who do."

"Texas A&M University students are responsible for authenticating all work submitted to an instructor. If asked, students must be able to produce proof that the item submitted is indeed the work of that student. Students must keep appropriate records at all times. The inability to authenticate one's work, should the instructor request it, may be sufficient grounds to initiate an academic misconduct case" (Section 20.1.2.3, Student Rule 20).

You can learn more about the Aggie Honor System Office Rules and Procedures, academic integrity, and your rights and responsibilities at aggiehonor.tamu.edu.

Americans with Disabilities Act (ADA) Policy

Texas A&M University is committed to providing equitable access to learning opportunities for all students. If you experience barriers to your education due to a disability or think you may have a disability, please contact Disability Resources in the Student Services Building or at (979) 845-1637 or visit disability.tamu.edu. Disabilities may include, but are not limited to attentional, learning, mental health, sensory, physical, or chronic health conditions. All students are encouraged to discuss their disability related needs with Disability Resources and their instructors as soon as possible.

Title IX and Statement on Limits to Confidentiality

Texas A&M University is committed to fostering a learning environment that is safe and productive for all. University policies and federal and state laws prohibit gender-based discrimination and sexual harassment, including sexual assault, sexual exploitation, domestic violence, dating violence, and stalking.

With the exception of some medical and mental health providers, all university employees (including full and part-time faculty, staff, paid graduate assistants, student workers, etc.) are Mandatory Reporters and must report to the Title IX Office if the employee experiences, observes, or becomes aware of an incident that meets the following conditions (see University Rule 08.01.01.M1):

- The incident is reasonably believed to be discrimination or harassment.
- The incident is alleged to have been committed by or against a person who, at the time of the incident, was (1) a student enrolled at the University or (2) an employee of the University.

Mandatory Reporters must file a report regardless of how the information comes to their attention – including but not limited to face-to-face conversations, a written class assignment or paper, class discussion, email, text, or social media post. Although Mandatory Reporters must file a report, in most instances, you will be able to control how the report is handled, including whether or not to pursue a formal investigation. The University's goal is to make sure you are aware of the range of options available to you and to ensure access to the resources you need.

Students wishing to discuss concerns in a confidential setting are encouraged to make an appointment with Counseling and Psychological Services (CAPS).

Students can learn more about filing a report, accessing supportive resources, and navigating the Title IX investigation and resolution process on the University's Title IX webpage.

Statement on Mental Health and Wellness

Texas A&M University recognizes that mental health and wellness are critical factors that influence a student's academic success and overall wellbeing. Students are encouraged to engage in proper self-care by utilizing the resources and services available from Counseling & Psychological Services (CAPS). Students who need someone to talk to can call the TAMU Helpline (979-845-2700) from 4:00 p.m. to 8:00 a.m. weekdays and 24 hours on weekends. 24-hour emergency help is also available through the National Suicide Prevention Hotline (800-273-8255) or at suicidepreventionlifeline.org.

COVID Syllabus Statement for Fall 2021

To help protect Aggieland and stop the spread of COVID-19, Texas A&M University urges students to be vaccinated and to wear masks in classrooms and all other academic facilities on campus, including labs. Doing so exemplifies the Aggie Core Values of respect, leadership, integrity, and selfless service by putting community concerns above individual preferences. COVID-19 vaccines and masking — regardless of vaccination status — have been shown to be safe and effective at reducing spread to others, infection, hospitalization, and death.