Course Information:

Course Title:	Electricity and Magnetism for Students in Engineering and Science
Course Number:	PHYS 207 (THECB common course number: PHYS 2326)
Credit Hours:	3 SCH (3 lecture plus 1 recitation)
Term and Section:	XX
Meeting times and location:	XX
Pre-requisites:	Grade of C or better for PHYS 206 and PHYS 216/ENGR 216; and MATH 152 or MATH 172 or equivalent
Co-requisites:	PHYS 217/ENGR 217

Instructor Information:

Instructor:	XX
Telephone:	XX
Email:	XX
Office:	XX
Office hours:	XX

Course Description:

A calculus-based course on electricity and magnetism. This is the second semester of a two-semester sequence in introductory physics for students in Science and Engineering. By the end of the course students will have developed a basic understanding of electromagnetic phenomena, learned the basic laws of electricity and magnetism, and developed the ability to solve science and engineering problems that involve charges, electromagnetic fields and electrical circuits.

Required Materials:

Primary text	University Physics (Volume 2) by Young and Freedman, 14th ed., with Modern Physics for Modified Mastering. ISBN13: 9781323390382.
Homework (Mastering)	All 207 sections use the ModifiedMastering on-line homework system.
Clicker	Get the iClicker2 from your bookstore. The iClickers will be used for in-class conceptual testing and polling. To encourage class participation, credit for iClickers will be based in part on participation, as well as additional points based on correct answers.
Pre-Lectures (FlipItPhysics)	All 207 sections use the http://www.flipitphysics.com on-line pre-lecture system (formerly known as SmartPhysics). You are required to view the prelectures (narrated slides including a few online questions) ahead of the lectures, and the lectures will include quizzes to see if you have gained a basic understanding. The remainder of the lecture will then focus more on problem-solving.

Grading Policies:

Exams: There will be 4 common evening exams (3 "midterm" exams and 1 "comprehensive" exam). Each of these will be given in the evenings as listed in the course schedule during the registration procedure. The midterm exams start at or around 7:30 PM, and are expected to last 1.5

hours. The comprehensive exam will last 2 hours. Exams generally consist of problems similar in content and difficulty to the recitations or homework, and they are expected to include both multiple-choice and free response questions. Students only need to bring their TAMU ID, a pen/pencil and hand-held calculator. Any contestations regarding the grading of an exam must be brought to the instructor's attention within 1 week of them being returned to the student.

Absences: If you miss an exam due to an *authorized excused absence* as outlined in the *University Regulations, Student Rule 7: http://student-rules.tamu.edu/rule07*. Rule 7.1.6.2a is not acceptable. You should attempt to ***contact the instructor prior to the exam but no later than the end of the week of the missed exam*** to arrange for a way to make up the score. Instead of taking a make-up exam, the final cumulative exam grade will be based on a set of tested objectives in the other exams.

Note: Few conditions qualify as an authorized excused absence, so you must avoid missing exams except for extremely serious circumstances.

Course Grade: The final letter grade on the course is based upon the final numerical course score as detailed in the table below. The column on the left shows the minimum scores necessary to achieve the final letter grade show in the right column.

Course Score	Final Letter Grade
≥ 90 %	A
≥ 80 %	B
≥ 65 %	C
≥ 50 %	D
< 50 %	F

The numerical score is computed as a weighted average over all different components of the course with the weights as determined in the table below. With the exception of the clicker quizzes all components of the course, such as tests/labs/recitation/homework/etc, are common across all sections of PHYS 207.

Course Component	Weight
Exams (Three Midterms + Comprehensive one)	80%
Recitation	5%
Online homework	5%
Pre-lectures and Checkpoints	5%
In-class clicker quizzes	5%
Total:	100%

The "Exams" portion includes the three midterm exams as well as the comprehensive one. Exams are graded in terms of the learning objectives. This type of grading removes the multiple punishment that is associated with failing the same learning objective repeatedly across exams. The complete list of learning objectives that a student is supposed to master at the end of the semester is posted at physics207.physics.tamu.edu/los.html

Each exam tests several different learning objectives and could test many times the same learning objective. During the grading we keep track of every instance in which a learning objective is tested and whether in that particular instance the objective was marked as passed or failed. Learning objectives will also be tested multiple times across exams.

At the end of the semester we call achieved objectives as those who pass either one of the criteria below:

- were marked as passing **≥60%** of the tested times in the comprehensive exam.
- were marked as passing **≥60%** of the tested times in all exams in which they were tested, including the comprehensive one.

The number of achieved objectives at the end of the semester divided by the number of tested objectives gives the numerical grade in the "Exams" portion of the table above**.** As an example, if a student has achieved 60 objectives out of the total of 70 objectives tested, he/she has earned 86% of the Exams portion of the course grade.

Mode of Instruction:

This course is composed of several pedagogical elements to enhance instruction through peer-learning and visual aids as described below:

- **Prelectures:** short online pre-lectures to expose the students to professionally designed videos explaining the basic concepts for the first time and gathering student- feedback on what might not be understood from them.
- **Lectures:** flipped classroom lectures in which a brief review of the concepts is done targeting the feedback on the pre-lectures, followed by the application of the physics concept to everyday life and the solution of problems. The lectures take advantage of clicker quizzes (usually solved in group) to obtain instant feedback on the level of grasp of the different concepts.
- **Recitations:** carried in groups and led by a group of trained TA's and teaching fellows. Teaching fellows are typically engineering students that have pass the course recently with excellent grades and provide a fundamental peer-learning component to this course.
- **Homework:** individual online homework assignments.

Students should plan for three hours of preparation per credit hour each week of the term.

Student-Instructor Interaction

A website common to all sections of the course is the main source of general information. Grades and information specific to the sections will be held in eCampus. The lecture instructor, the TAs and Teaching Fellows will host office hours and Q&A sessions.

Americans with Disabilities Act (ADA)

The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact Disability Services, currently located in the Disability Services building at the Student Services at White Creek complex on west campus or call 979-845-1637. For additional information, visit http://disability.tamu.edu.

Aggie Honor Code

"An Aggie does not lie, cheat or steal, or tolerate those who do." For additional information, please visit http://aggiehonor.tamu.edu.

Course Topics and Calendar of Activities:

Week	Lecture topic
1.	Electric Charge and Electric Field: Electric charge, Coulomb's law
2.	Electric Charge and Electric Field: Electric Field, Electric Dipoles
3.	Gauss' Law: Electric flux, Gauss's law, Applications of Gauss's Law
4.	Electric Potential: Electric Potential Energy, Electric Potential, Equipotential Surfaces, Potential Gradien . **Exam 1.**
5.	Capacitance and Dielectrics: Capacitors and Capacitance, Capacitors in Series and in Parallel, Energy storage in capacitors, Electric Field energy, Dielectrics, Gauss's Law in Dielectrics
6.	Currents, Resistance, and Electromotive Force: Current, Resistivity, Resistance, EMF, Intro to circuits, energy and power in circuits
7.	DC Circuits: Resistors in series and in parallel, Kirchhoff's Rules, RC-circuits, Power distribution systems
8.	Magnetic Fields and Magnetic Forces: Magnetic Field, Magnetic Field lines and magnetic flux, Motion of Charged Particles in a Magnetic Field and Applications, Current-carrying conductor in a magnetic field, Forces and torques on a current loop in mag. field, motors, Hall effect. **Exam 2.**
9.	Sources of Magnetic Field: M-field of moving charge, M-field of current element, M-field of straight current-carrying conductor, forces between parallel conductors, M-field of a circular current loop, Ampere's law and applications
10.	Electromagnetic Induction: Faraday's law, Lenz's law, Motional EMF, Induced Electric field, Eddy currents, Displacement current and to Maxwell's Equations
11.	Inductance: Mutual Inductance, self-inductance and inductors, magnetic field energy, RL circuit, LC circuit, LRC circuit
12.	Alternating Current: Phasors and AC, Reactance, LRC circuit with AC source and impedance, power in AC circuits, resonance in AC, transformers. **Exam 3.**
13.	Electromagnetic waves: Maxwell's equations and EM waves, plane EM waves, sinusoidal EM waves, Energy and Momentum in EM waves, Poynting vector, standing waves
14.	Special topics: standing EM waves, EM waves modulation in telecom., propagation of light, refraction, reflection, Snell's law, Review. **Final.**

Detailed Learning Objectives:

Mathematical Tools to Solve E&M Problems

- Be able to compute the components of a vector in any given coordinate system
- Be able to compute addition, scalar, and vector products between vectors
- Be able to solve for an unknown quantity in a single equation when possible
- Be able to solve a system of N equations with N unknown variables
- Be able to translate verbal constraints into mathematical language
- Be able to translate mathematical results to verbal interpretations
- Be able to do integrals and take derivatives

Electric Charge and Coulomb's Law

- Calculate the electric force between charges using Coulomb's Law
- Calculate the Coulomb force exerted on a charged particle by other charged particles, using Coulomb's Law and Superposition
- Calculate the electric field produced by a point charge
- Calculate the electric field due to a collection of point charges and understand the distinction between electric force and electric field
- Calculate the electric field caused by a continuous distribution of charge
- Be able to interpret electric field lines
- Calculate the force and torque on an electric dipole due to an external electric field, and the potential energy of an electric dipole
- Gauss' Law
- Articulate the concept of electric flux and be able to calculate the electric flux through a surface
- Formulate how Gauss' Law relates the electric flux through a closed surface to the charge enclosed by the surface
- Articulate under what conditions Gauss' Law is useful for determining electric field
- Be able to use Gauss' Law to calculate the electric field due to a symmetric charge distribution
- Describe the electric field within a conductor and where the charge is located on a charged conductor.

Electric Potential

- Calculate the electric potential energy of a collection of charges
- Use conservation of energy to solve a problem with electric forces
- Articulate the meaning and significance of electric potential
- Calculate the electric potential that a collection of charges produces at a point in space
- Calculate the electric potential due to a continuous distribution of charges
- Be able to use electric potential to calculate electric field
- Be able to calculate the electric potential from the electric field
- Capacitance and Dielectrics
- Identify the nature of capacitors and be able to quantify their ability to store charge (i.e. the capacitance)
- Be able to combine the calculation of fields and potential functions to derive the capacitance of the three soluble systems
- Analyze capacitors connected in a network (by determining equivalent capacitance for capacitors connected in series or parallel)
- Calculate the amount of energy stored in a capacitor
- Articulate how dielectrics make capacitors more effective (and how a dielectric within a charged capacitor becomes polarized)
- Be able to apply Gauss' Law when dielectrics are present

Current, Resistance, and Electromotive Force

- Calculate the resistance of a conductor from its dimensions and resistivity
- Articulate Ohm's Law both in terms of the resistivity of a material (the microscopic form of Ohm's Law) and in terms of the resistance (macroscopic form of Ohm's Law)

- Articulate the concept of electromotive force (emf) and how emf makes it possible for current to flow in a circuit
- Identify the symbols used in circuit diagrams
- Calculate energy and power in a circuit

Direct-Current Circuits

- Analyze circuits with multiple resistors in series or parallel
- Articulate Kirchhoff's Rules
- Apply Kirchhoff's rules to analyze circuits
- Articulate the functionality of ammeters and voltmeters and under what conditions these instruments are "idealized"
- Analyze R-C Circuits

Magnetic Field and Magnetic Forces

- Articulate the force exerted by a magnetic field on other moving charges or currents
- Interpret magnetic field lines and calculate magnetic flux through a surface
- Calculate the motion of charged particles in magnetic and electric fields
- Calculate the magnetic force on a current-carrying wire
- Calculate the torque on a magnetic dipole and the potential energy of a magnetic dipole in an external magnetic field
- *Sources of Magnetic Field*
- Calculate the magnetic field due to a point charge with constant velocity
- Calculate the magnetic field due to a current (using Biot-Savart Law)
- Calculate the force between two long parallel conductors
- Apply Ampere's Law to calculate the magnetic field
- Recognize under what conditions Ampere's Law is useful to determine the magnetic field

Electromagnetic Induction

- Be able to calculate magnetic flux through a surface
- Articulate how Faraday's Law relates the induced emf in a loop to the time-derivative of magnetic flux through the loop and be able to apply it to calculate induced emf
- Apply Lenz's Law to determine the direction of an induced emf
- Calculate the emf induced in a conductor moving through a magnetic field
- Calculate the induced electric field generated by a changing magnetic flux
- Articulate the concept of displacement current and be able to calculate it for a changing electric flux through a surface

Inductance

- Calculate mutual inductance and induced emf due to mutual inductance
- Articulate the concept of self-inductance and be able to relate the magnetic flux and current to the self-inductance
- Calculate the energy stored in a magnetic field
- Analyze R-L circuits and describe the time-dependence of the current
- Analyze L-C circuits and describe the time-dependence of the current
- Recognize the time-dependence of the current in an L-R-C circuit

Alternating-Current Circuits

- Analyze an L-R-C series circuit with a sinusoidal emf

- Understand the origin of resonances in L-R-C circuits (analogous to forced, damped harmonic oscillator)
- Determine the amount of power flowing into or out of the alternating-current circuit

Electromagnetic Waves

- Articulate the key properties of electromagnetic waves (wave is transverse, relationship between E and B, speed of wave)
- Be able to reproduce the wave equation mathematically and articulate the meaning of all quantities in the mathematical formulation of sinusoidal electromagnetic plane wave.
- Use the Poynting vector to calculate the energy and momentum carried by the electromagnetic wave