Physics for Science and Engineering 2
(PHY 0175)
Spring 2025

Course Description

Instructor

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Office: 516 New SCUPI Building

Classroom: **S206 New SCUPI Building**
Lectures: Monday**,** Tuesday, Wednesday and Thursday

Sections: 1, 2, 3 and 4

Office Hours: Monday 2 – 3 PM, Friday 3 - 4 PM

Physics seeks to describe and predict natural events by seeking the relationships between motion, force, energy and time. Physics is at the root of all types of engineering; mechanical, electrical, nuclear, chemical, etc. Physics 2 (PHY 0175) is the second semester of a one-year sequence of courses in physics — a continuation of Physics 1 (PHY 0174). The course provides a calculus-based introduction to electrostatic field in free space and in dielectrics; magnetic fields due to steady and varying currents; electromagnetic induction; magnetic materials, Maxwell's equations and wave optics.

Students cultivate their understanding of physics through inquiry-based investigations as they explore these topics. The course will stress a conceptual understanding of everyday phenomena and recent technologies in terms of their basic underlying physical principles. Emphasis will be placed on understanding physical science literacy and applying physics concepts to think critically and solve problems. Blended problem-based conceptual learning will be used to gain an understanding of key developments, ideas and theories covered in this course. At the end of this course students will have a deeper understanding of concepts in electromagnetism and wave optics and be able to solve time-dependent problems in these areas. Additionally, Physics 2 covers a great deal of material which is directly relevant for various engineering programs and has been historically popular for electric, electronic and communication engineering majors.

Prerequisites
Students are assumed to have a basic understanding of the principles and practices of Physics 1 and MA 0240 & MA 0290.

Course Learning Outcomes (CLOs)

On satisfying the requirements of this course, students will have the knowledge and skills to:

- CLO1 Describe and understand the basic concepts underpinning electricity and magnetism such as potential and field,
- CLO2 Understand the relationship between electric and magnetic fields,
- CLO3 Calculate the electrostatic and magnetic fields produced by static and moving charges in a variety of simple configurations.
- CLO4 Identify and apply appropriate theoretical techniques to solve a range of different problems in electromagnetism.
- CLO5 Demonstrate the ability to use appropriate mathematical techniques and concepts to obtain quantitative solutions to problems in physics.
- CLO6 Demonstrate the ability to use appropriate mathematical techniques and concepts to obtain quantitative solutions to problems in physics.
- CLO7 Be able to combine multiple concepts and apply them to real-world concepts you are likely to see in a career in science, technology, or engineering.

Resources

Prescribed Textbook:

Principles of Physics, 10th Edition, International Student Version, Robert Resnick, David Halliday and Jeal Walker, 2014, John Wiley & Sons, 2014

Supplementary/Further Reading:

Physics for Scientists and Engineers with Modern Physics, 8th Edition, Douglas C. Giancoli, Pearson Education, Inc. NJ, 2015

Technological Resources (Virtual Lab)

Students may find the virtual simulations an effective tool for the operations of real-world processes or systems. The computer simulations are widely used and are available for free at

https://phet.colorado.edu/en/simulations/category/physics

http://www.walter-fendt.de/ph14e/

Blackboard

Please regularly log on and check https://pibb.scu.edu.cn/. Lecture notes, online quizzes, assignments, projects, announcements, and your grades will be uploaded on the PHY 0175 page of the Blackboard.

Tutorials

Tutorials run by our TAs will start in Week 02.

Course Assessment

The final grade will be computed based on the score of weekly assignments, quizzes, midterm, and final exams.

Assessment Weightage

The final grade will be computed according to the following scheme:

Assignment/Homework:	10%
Attendance:	05%
Quizzes:	20%
Midterm:	30%
Final Exam:	35%

Cutoffs

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+ [61, 63), D [60, 61), F (60, 0).

Quizzes: In-class/online quizzes will be conducted every week, starting from week 2 of this semester.

Assignments/Homework

Homework will be assigned every week and due by the following weekend. No late homework is accepted, and plagiarism is not tolerated. Like quizzes, homework is also randomised, and students are expected to submit the solutions online. Discussions on the homework problems are encouraged. For collaborative assignments, grading rubrics are used for *objective and consistent assessment of various performances, assignments, and activities.* The rubrics for the collaborative projects/assignments will be uploaded to the Blackboard.

Course Policies

During Class

Computers may be allowed in class for the electronic recording of notes. But please refrain from using computers for any activities unrelated to the course. Phones are prohibited as they are rarely helpful for anything in the course. Eating and drinking are allowed in class, but please keep from it affecting the course.

Attendance Policy

Attendance is expected in all lectures. Valid excuses for absence will be accepted before class. In extenuating circumstances, valid excuses with proof will be accepted after class.

Policies on Late Assignments and Exams

Students should start their homework assignments immediately after they are given, and DO NOT wait until the last minute to meet the deadlines. Late assignments will be NOT accepted except for emergencies and health issues. Any other late assignments handed in will be marked but will be given a zero mark. All assignments will be counted in your total grade. Late submission for previous assignments during the final exam period will NOT be accepted in any form for any excuses.

All tests and the final exam are mandatory. There will be no makeup exam for any quizzes and assignments. If you miss the midterm or final exam, a makeup exam may be given if the student has approval from the instructor or emergencies and health issues with valid proof. I will not accept the student deceleration for absence form for the final exam.

Academic Assistance

You are encouraged to attend office hours if you have questions regarding class materials, homework problems, grading issues, etc. Otherwise, you may email the TA or the instructor. Please allow 24 to 48 hours for any response to emails. The subject of each email must include "[PHY 0175]". For example, if you have a question regarding a homework problem, the email's subject could be [PHY 0175] Question about Problem X of Assignment X. Please make sure that you sign off with your official name (the one that appears in Blackboard). You are encouraged to use academic language in your posts.

Academic Integrity

At Sichuan University, we are guided by the values of academic integrity: honesty, trust, fairness, responsibility, and respect (The Centre for Academic Integrity, Duke University, 1999). As a student, you must demonstrate these values in all your work. Everyone at SCUPI is expected to treat others with dignity and respect. The Code of Student Conduct allows Sichuan University to take disciplinary action if students do not follow this community expectation.

Special Needs:

The Office of Special Needs Services at Sichuan University ensures that students with special needs have equal access to the campus and course materials. We will work with the Office of Special Needs to provide adequate services to students with special needs.

Topical Outline of the Course Contents

The schedule is tentative and subject to change. The listed objects below should be viewed as the key concepts you should grasp after each week and as a study guide before each exam and at the end of the semester.

Teaching Plan

Week	Topics	Learning outcomes
1	***Chap 21: Coulomb's Law and Electric Force*** - Electric Charge and Coulomb's Law - Conservation and Quantization of Charge Electrostatic Force for a System of Charges - Electric Field – Properties of Electric Lines of Force	✓ Describe the electric force, both qualitatively and quantitatively. ✓ Determine the direction of the electric force for different source charges. ✓ Correctly describe and apply the superposition principle for multiple source charges.
2	***Chap 22: Electric Field*** - Electric Field due to a Charged Particle and Discrete System of Charges - Electric Field Due to a Dipole - Continuous Charge Distributions	✓ Determine the electric field due to discrete and continuous system of charges.

3	***Electric Field (Contdd.)*** - Electric Field due to a Line of Charge and Charged Disk - A Charged Particle in an External Electric Field - A Dipole in an Electric Field	✓ Interpret and apply the concepts of volume, surface and line charge densities to calculate via integration the electric field vector produced by continuous charge densities. ✓ Describe the forces and torques exerted on an electric dipole in a field.
4	***Chap 23: Gauss' Law*** - Electric Flux - Gauss's Law - Applying Gauss's Law – • Planar symmetry • Cylindrical symmetry and • Spherical Symmetry	✓ Use Gauss' law to calculate the electric field due to a given charge distribution
5	***Chap24: Electric Potential*** - Conservative Force and Potential Function - Electric Potential and Potential Energy - Equipotential Surfaces - Potential due to a Charged Particle and due to a Group of Charges - Potential due to an Electric Dipole	✓ Determine the scalar electric potential of a source charge and charge distributions. ✓ Describe qualitatively the motion of positive or negative charges in a region of space given the electric potential.
6	***Chap24: Electric Potential (Contd.)*** - Potential due to a Continuous distribution of Charge - Calculating electric Field from Potential - Electric Potential Energy of a System of Charged particles - Potential of a Charged isolated Conductor	✓ Understand how to calculate electric potential due to a charge distribution ✓ Understand how to use electric potential to determine electric potential energy ✓ Understand how to determine electric potential from electric field
7	***Chap 25: Capacitance*** - Calculating Capacitance - Capacitors in Parallel and Series - Energy Stored in an Electric Field - Capacitor with a Dielectric - Dielectrics and Gauss's Law	✓ Explain how energy is stored by a capacitor and determine how much energy is stored in a capacitor/set of capacitors. ✓ Describe how a dielectric affects capacitance. ✓ Reason about relationships among potential difference, field, charge and stored energy in a capacitor.

8	***Chap 26: Electric Current and Resistance*** - Current, drift velocity and current density - Resistance and its' dependence on temperature - Resistivity, conductivity and temperature - Resistance thermometer - EMF and electric circuits - Energy and Power in Electric Circuits - Theory of Metallic Conduction	✓ The meaning of electric current, and how charges move in a conductor. ✓ What is meant by the resistivity and conductivity of a substance. ✓ How to calculate the resistance of a conductor from its dimensions and its resistivity. ✓ How an electromotive force (emf) makes it possible for current to flow in a circuit.
8	***Midterm Exam (weekend)***	**Chapter 21 - 25**
9	***Chapter 28: Magnetic Fields and Magnetic Forces***: - Electric Currents Produce Magnetic Fields, - Force on an Electric Current in a Magnetic Field - Magnetic Field Lines and magnetic Flux - Force on an Electric Charge Moving in a Magnetic Field - ***Inquiry-based Activity***: Electromagnetic Pumping	✓ The properties of magnets, and how magnets interact with each other. ✓ The nature of the force that a moving charged particle experiences in a magnetic field. ✓ How magnetic field lines are different from electric field lines. ✓ What goes on inside a magnetic?
10	***Chapter 28: Magnetic Fields and Magnetic Forces (Contd.)*** - Torque on a Current Loop; Magnetic Dipole Moment - Applications of Motion of Charged Particles: Motors, Loudspeakers, Galvanometers, Mass Spectrometer - Discovery and Properties of the Electron - The Hall Effect - ***Inquiry-based Activity***: The puzzle of a velocity-dependent force	✓ How to analyse the motion of a charged particle in a magnetic field! ✓ Some practical applications of magnetic fields in chemistry and physics. ✓ How to analyse magnetic forces on current-carrying conductors. ✓ How current loops behave when placed in a magnetic field.
11	***Chapter 29: Sources of Magnetic Field*** - Magnetic Field of a Moving Charge, - Magnetic Field of a Current Element - Magnetic Field of a Straight Current-Carrying Conductor - Force Between Parallel Conductors	✓ The nature of the magnetic field produced by a single moving charged particle. ✓ How to describe the magnetic field produced by an element of a current-carrying conductor. ✓ How to calculate the magnetic

		field produced by a long, straight, current-carrying wire. ✓ Why wires carrying current in the same direction attract, while wires carrying opposing currents repel.
12	***Chapter 29: Sources of Magnetic Field (Contd.)*** - Magnetic Field of a Circular Current Loop, Ampere's Law - Applications of Ampere's Law - Biot-Savart Law - Current Carrying Conductor as a magnetic Dipole ***Inquiry-based Activity***: Solenoid switches: car starters, doorbell	✓ How to calculate the magnetic field produced by a current-carrying wire bent into a circle. ✓ What Ampere's law is, and what it tells us about magnetic fields. ✓ How to use Ampere's law to calculate the magnetic field of symmetric current distributions.
13	***Chapter 30: Induction and Inductance*** - Faraday's Law - Lenz's Law - Motional Electromotive Force - Induced Electric Fields & Induced Electric Current - Induction and Energy Transfers - Displacement Current	✓ The experimental evidence that a changing magnetic field induces emf. ✓ How Faraday's law relates the induced emf in a loop to the change in magnetic flux through the loop. ✓ How to determine the direction of an induced emf.
14	***Chapter 30: Induction and Inductance (Contd.)*** - Inductors & Inductance - Mutual Inductance, Self-Inductance and Inductors - RL Circuit & Energy Stored in a Magnetic Field	✓ How to determine the direction of an induced emf. ✓ How to calculate the emf induced in a conductor moving through a magnetic field.
14	***Chapter 32: Maxwell's Equations – Magnetism of Matter*** - Changing Electric Fields Produce Magnetic Fields - Ampere's Law and Displacement Current - Current flowing into a Capacitor and the Law of Conservation of Charge with the idea of the Displacement Current. - Gauss's Law for Magnetism - Induced Magnetic Fields	✓ Properties of electric and magnetic fields. ✓ How Faraday's law of electromagnetic induction relates to the curl of the electric field ✓ How Maxwell's equations lead to electromagnetic waves and how the speed of light is related to static properties of the vacuum. ✓ Solve simple problems involving electromagnetic waves in free space.

15	***Chapter 32 Maxwell's Equations – Magnetism of Matter (Contd.)*** - Maxwell's Equations - Electromagnetic Waves and Their Speed, from Maxwell's Equations - Magnetic Materials: Diamagnetism, Paramagnetism and Ferromagnetism	✓ How the speed of light is related to the fundamental constants of electricity and magnetism ✓ How to describe the propagation of a sinusoidal electromagnetic wave
16	**Chapter 33 : Electromagnetic Waves** - Light as an Electromagnetic Wave and the Electromagnetic Spectrum - Energy in EM Waves; the Poynting Vector - Reflection of EM Waves	✓ Why there are both electric and magnetic fields in a light wave. ✓ What determines the amount of power carried by an electromagnetic wave.
17	**Chapter 33 : Electromagnetic Waves** - Refraction of EM waves - Polarization of EM Waves - Applications: Radiation Pressure, Wireless Communication - ***Revision***	✓ How to describe standing electromagnetic waves.
18	**Final Examination**	