

Visual E&M

Introduction

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A FOCUSED CONCEPT LAB

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Course Description

Visual E&M is a one semester laboratory introduction to electricity and magnetism. The first half of the semester focuses on the electrostatic field. It culminates with a measurement of the electric field by visually analyzing the deflection of electrons in a parallel plate geometry. The second half of the semester focuses on the magnetostatic field. It culminates with a measurement of the magnetic field by visually analyzing the deflection of electrons in a Helmholtz coil geometry. The goal, at the end of the semester, is to combine these measurements to obtain a value for the charge-to-mass-ratio of the electron using J. J. Thompson's classic method of "ExB fields".

Communication, team work, and critical thinking are enhanced by the structured environment of cooperative learning groups. The groups are patterned after "teams" that might exist at a small company. Each team consists of four students identified by a picture ID that contains their title as "Manager", "Publicist", "Tech Writer", or "Skeptic". Team assignments are rotated periodically to insure that student has the opportunity to perform one of the well-defined tasks within the same or different teams. Each team reviews the experiment and each team member shares responsibility for collecting data. Ample time is allowed for analysis and discussion of the results. A class discussion provides a cohesive end to each experiment.

Lab Manual

Visual E&M is a “paperless lab”. Lab exercises will be accessed from a computer reserved for each team. The screen display will be used for all class activities. Blue colored text signifies a link to LabVIEW™ software or a link to topics that appear in the reference section of each exercise. Select blue colored text to activate a specific link. A hard copy of a lab exercise and/or its LabVIEW software can be obtained by downloading the appropriate file from a Website designated by your instructor. The lab exercises are saved as Adobe Systems® PDF files.

LabVIEW Software

LabVIEW™ is a crossplatform compatible, data flow programming language created by National Instruments. It is becoming the defacto standard for instrument control and data analysis in industry and academe. A copy of LabVIEW, version 5.1 or greater, is required to access the software that accompanies this manual. See the National Instruments Website for details: <http://www.ni.com/>

Textbook

No textbook is required. The reference section of this manual contains selected textbook material as required for each lab exercise.

Lab Notebook

You are required to purchase a hardbound lab notebook. The notebook will be used to record experimental data and summaries of team discussions. Lab notebooks will be collected periodically for review and evaluation.

Homework

Visual E&M is a self contained learning experience. Class discussions and summaries of team discussions serve in lieu of homework assignments.

Grading

Visual E&M is based on a limited grading system. Only three grades are possible: (A), (B) or Incomplete (I). Attendance at all labs is encouraged, but only one absence is allowed. Two or more absences will result in disenrollment from the class with a grade of (I). A grade of (I) will automatically become an (F) unless the entire laboratory is taken again during the next semester.

An up-to-date lab notebook is required for a grade of (A) or (B). Distinctions between an (A) and a (B) will be based on periodic examinations of your lab notebook and your participation in team and class discussion. A grade of (B) will result if an allowed absence is not supplemented by completing the missing lab exercise in a scheduled “makeup lab” during the semester.

Students with Disabilities



Qualified students with disabilities needing appropriate academic adjustments should contact your instructor as soon as possible to ensure your needs are met in a timely manner. Handouts are available in alternative accessible formats upon request.

Team Assignments

Manager

The manager has the responsibility to coordinate and direct team activities. In addition, the manager must ensure that the all equipment and lab furniture are restored to their original locations at the end of the lab.

Tech Writer

The tech writer has the responsibility to communicate team results in written form. Each lab exercise concludes with four discussion topics. Each team will highlight one of the topics for discussion and prepare a one paragraph summary of the discussion.

Publicist

The Publicist has the responsibility to present a summary of the team discussion to the class.

Skeptic

The Skeptic has the responsibility to ask questions during team activities. The skeptic should raise doubts and open a discussion on any activity that is not understood. The skeptic is free to ask “dumb” questions.

Fall Schedule

Week 1 Introduction.

Week 2 Lab 01 Conduction.

Week 3 Labor Day Holiday

Week 4 Lab 02 Electrostatics.

Week 5 Lab 03 Voltage.

Week 6 Lab 04 Equipotentials.

Week 7 Lab 05 Electrostatic Deflection.

Week 8 Fall Break

Week 9 Lab 06 Current and Resistance.

Week 10 Lab 07 Magnetic Pendulum.

Week 11 Lab 08 Helmholtz Coils I.

Week 12 Lab 09 Helmholtz Coils II.

Week 13 Lab 10 Electron Beam Tube.

Week 14 Thanksgiving Holiday

Week 15 Lab 11 Measure e/m

Week 16 Makeup Lab.

Week 17 Final Exam Week

Spring Schedule

Week 1 Martin Luther King Holiday

Week 2 Introduction.

Week 3 Lab 01 Conduction

Week 4 Lab 02 Electrostatics.

Week 5 Lab 03 Voltage.

Week 6 Lab 04 Equipotentials.

Week 7 Lab 05 Electrostatic Deflection.

Week 8 Makeup Lab.

Week 9 Spring Break

Week 10 Lab 06 Current and Resistance.

Week 11 Lab 07 Magnetic Pendulum.

Week 13 Lab 08 Helmholtz Coils I.

Week 14 Lab 09 Helmholtz Coils II.

Week 15 Lab 10 Electron Beam Tube.

Week 15 Lab 11 Measure e/m

Week 16 Makeup Lab.

Week 17 Final Exam Week