Revision date: May 2000
Revised by: Dr. C. Miranda

I. **Title of Course** : Physics Lab. II For Engineering Students

Codification : FISI-3174

Credits : One (1)

Contact Hours : Three (3) hours per session per week

Ten (10) experiments per semester

Pre-Requisite : FISI-3171, Physics I For Engineering Students

Pre-Requisite : FISI-3173, Physics Lab. I For Engineering Students

Co-Requisite : FISI-3172, Physics II For Engineering Students

Co-Requisite : MATE-3063, Calculus III

II. Course Description

FISI-3174 is the second semester of a two-semester laboratory sequence in physics for students majoring in sciences and engineering. Three hours a week, one hour of discussion and two hours of laboratory work. The experiments described in the course follow closely the standard sequence of subjects covered in the traditional two-semester introductory physics course for sciences and engineering majors. Includes experiments in electricity, static current, alternating current, Kirchhoff's Laws, geometrical and physical optics and modern physics. The computer is used to analyze experimental data taken with conventional laboratory apparatus. No background in computer programming is assumed.

III. Textbook, Notebook, Calculator, Floppy Disk and E-Mail

Textbook: Physics Laboratory Experiments, 5th Edition

This introductory laboratory manual for the calculus or non-calculus based college physics course provides a combination of hands-on (traditional) and computer-based instruction. The text covers basic physical principles while introducing laboratory procedures, techniques, and equipment.

Author: Jerry D. Wilson, Lander University
D. C. Heath and Company
Lexington, Massachusetts
ISBN: (0-395-87466-1) 578 Pages Paper 1998

Notebook: You will need a lab notebook. You may use any notebook, as long as the pages are quadrille ruled (i.e., graph paper) and bound into the notebook (either spiral or sewn binding).You will use the notebook for recording pre-experiment information, in-lab data (including preliminary analyses and graphs), to diagram the equipment and post-experiment calculations and analysis. Loose-leaf notebooks, non-quadrille and other obviously non-compliant notebooks are unacceptable.

Calculator: The student should have a hand-held scientific calculator for use in doing calculations in the laboratory, homework and exams. It doesn't need to be programmable, but it should compute square root, trigonometric functions, logarithms ($\boldsymbol{log_e(x)}$ and $\boldsymbol{log_{10}(x)}$)and exponential functions ($\boldsymbol{e^x}$ and $\mathbf{10^x}$).

Floppy disk: The student should have a 1.44 MB floppy disk formatted for an IBM compatible PC for use to store files and spreadsheets for lab reports. Data cannot be copied to the hard disks on the lab computers.

E-Mail: Every one is strongly encouraged to have an electronic mail address and should check their e-mail regularly. The laboratory instructors, support staff, and faculty in charge of the laboratory can all be reached via an e-mail link at the laboratory web site. Students are responsible for supplying a functioning e-mail address and checking for messages on a regular basis.

IV. General Objectives

The goal of the physics laboratory is to deepen your understanding of the physical concepts discussed in the classroom and to expose the student to some approaches encountered in experimental research. The laboratory course does not follow the development of physics concepts as encountered in the classroom, but rather focuses on a few well-defined physics problems that you may or may not have discussed in your physics lecture by the time you carry out your laboratory work. The physics laboratory puts you in a situation very similar to what you will encounter after graduation. You will be expected to solve specific problems, regardless of whether you have solved similar problems in your college career or have never seen such problems before.

V. Specific Objectives

After satisfactory completion of this course, the student is expected to be able:

1. To apply course material to improve rational thinking, problem solving, and decision- making.

1. To develop skills in making observations and drawing conclusions based on those observations.

2. To develop skills in data acquisition and analysis methods.
3. To obtain experimental values of specific physical quantities and compare them with their theoretical or accepted value.
4. To gain skills required to work both independently and collaboratively.
5. To develop the student's competency in the art and mechanics of technical report writing.
6. To prepare technical material for oral presentation to a group of peers.
7. To use graphs as an analysis tool. In particular, methods for finding the straight line and the uncertainties best representing the data are emphasized.

VI. Groups and Seating

Groups: Experiments are to be performed in groups of no more than three students. You should work with your lab partners in such a way that each of you fully participates in the experiment. Mutual discussion and cooperative analysis are encouraged, but each student is expected to record his/her own measurements of data in the lab notes, perform all necessary calculations, and write up results, analyses, and answers to assigned questions.

Seating: Seating will be assigned on the first day of class, and your partner will be the student sitting at the same table as you. Thereafter, you will remain on the same side of the laboratory room for the remainder of the semester; however, the instructor will reassign seating and partners at the end of each experiment.

VII. Laboratory Experiments to be Discussed

All laboratory assignments and readings will be announced either in your lecture or in the previous week's lab. It is your responsibility to be aware of the lab assignment for each week. You should read through the lab manual for the lab before you arrive. Mark down any sections or derivations you do not understand and ask about them at the beginning of the lab. In this laboratory course, you will perform at least ten (10) experiments from the following list, which are representative to the material covered in the lectures.

1) Fields and Equipotentials (3 hours)

2) Ohm's Law (3 hours)

3) The Potentiometer: EMF and Terminal Voltage (3 hours)

4) The Voltmeter and Ammeter (3 hours)

5) The Measurement of Resistance: Ammeter-Voltmeter Methods and Wheatstone Bridge Method (3 hours)
6) Resistivity (3 hours)
7) The Temperature Dependence of Resistance (3 hours)
8) Resistance in Series and Parallel (3 hours)
9) Multiloop Circuits: Kirchhoff's Rules (3 hours)
10) Joule Heat (3 hours)
11) The RC Time Constant (3 hours)
12) Phase Measurements and Resonance in AC Circuits (3 hours)
13) Electromagnetic Induction (3 hours)
14) Reflection and Refraction (3 hours)
15) Spherical Mirrors and Lenses (3 hours)
16) Polarized Light (3 hours)
17) The Prism Spectrometer: Dispersion and the Index of Refraction (3 hours)
18) Line Spectra and the Rydberg Constant (3 hours)
19) The Transmission Diffraction Grating: Measuring the Wavelengths of light (3 hours)
20) The Mass of an Electron: *e/m* Measurement (3 hours)
21) Detection of Nuclear Radiation: Geiger Counter (3 hours)
22) Radioactive Half-life (3 hours)
23) The Absorption of Nuclear radiation (3 hours)

VIII. Attendance

All students, including those repeating the course, must be registered and attend the lab section for which they are registered. Credit will not be given for any work done in lab sections for which students are not enrolled. You are expected to attend all the labs without exception. If you know in advance that you must miss your lab, you are expected to do your best to make up for it by attending another lab session the same week. An absence will be excused only if supported by valid reasons (e.g. sickness, death in the family, automobile accidents, and other *unforeseeable emergencies*) and signed documentation (e.g., a letter from your doctor, letter from the dean, police report, etc. Unexcused absences will be penalized heavily: If you have one unexcused absence, your maximum grade will be a **B**, for two unexcused absences it will be a **C**, for three unexcused absences it will be a **D**, and for four or more unexcused absences you will automatically receive an **F**. Note that these are the maximum grade you can get assuming perfect performance. Your actual grade could be even lower. If you are more than 15 minutes late - you have missed your lab and will need to follow the procedures for missed labs.

IX. Evaluation Criteria

1) Your grade will be based on results submitted on lab reports, individual performance in such areas as group work, equipment management, punctuality, classroom behavior, quality and amount of extension activities and two lab exams.

Laboratory Reports	=	60%
Individual Performance	=	10%
Two (2) Lab Exams	=	30%
Total	=	100%

Grading Scheme:

100 - 90%	A
89 - 80%	B
79 - 70%	C
69 - 60%	D
59 - 0%	F

X. Educational Support Material

1) Articles from journals and magazines as,

a) Scientific American
b) Astronomy
c) American Journal of Physics
d) Science
e) Physics Today

are frequently assigned as requested reading.

2) Several experimental demonstrations are performed in laboratory using simple devices.

3) The resources of a library, the Internet and other sources to determine the background information about topics in physics.

XI. Instructor and Student References

1) Physics for Scientists and Engineers, with Modern Physics
Serway, Raymond A.
4th ed., Saunders College Pub. c1996.

2) Physics for Scientists and Engineers
Fishbane, Paul M., Gasiorowicz, Stephen G. and
Thornton, Stephen T.
2nd ed., Prentice-Hall, Inc., c1996

3) University Physics
Sears, Francis W., Zemansky, Mark W. and Young, Hugh D.
Seventh Edition (1987)
Addison-Wesley Publishing Co.

4) Physics
Tipler, Paul A.
Second Edition (1982)
Worth Publishers, Inc.

5) Mechanics
Berkeley Physics Course, Volume 1
Second Edition (1973)

6) Physics
Kane, Joseph W. and Sternheim, Morton M.
Third Edition, 1988
John Wiley & Sons

7) Conceptual Physics

Hewitt, Paul G.
Sixth Edition, 1988
Scott, Foresman and Company

8) The mechanical Universe (1985)
Olenick, Richard P., Apostol, Tom M., Goodstein, David L
Cambridge University Press

9) Beyond The Mechanical Universe (1986)
Olenick, Richard P., Apostol, Tom M., Goodstein, David L
Cambridge University Press

10) Contemporary College Physics (1990)
Jones, Edwin R. and Childers, Richard L.
Addison-Wesley Publishing Co.

(This books related to the topics in this course have been placed in the library)

XII. General Laboratory Safety Rules

8. Listen to or read instructions carefully before attempting to do anything.

2. Wear safety goggles to protect your eyes from chemicals, heated materials, or things that might be able to shatter.

3. Notify your professor if any spills or accidents occur.

4. After handling chemicals, always wash your hands with soap and water.

5. During lab work, keep your hands away from your face.

6. Tie back long hair.

7. Roll up loose sleeves.

8. Know the locations of the fire extinguisher, fire blanket, eyewash station, and first aid kit.

9. Keep your work area uncluttered. Take to the lab station only what is necessary.

10. It is suggested that you wear glasses rather than contact lenses.

11. Never put anything into your mouth during a lab experiment.

12. Never “horse around” or play practical jokes in the laboratory.

13. Never taste any chemicals (you should never taste anything in the lab).

14. Lay electrical cords where no one can trip on them or get caught in them.

15. Be sure your hands and your lab area are dry before using electrical equipment.

16. Never poke anything into electrical outlets.

17. Unplug cords by pulling the plug and not the cord.

18. Unplug all electrical equipment at the end of the lab period.

19. Report any equipment that you suspect is malfunctioning.

20. If a thermometer breaks, inform the instructor immediately. Do not touch either the broken glass or the mercury with your bare skin.

21. Ask the instructor to check all electrical circuits before you turn on the power.

22. When working with electrical circuits, be sure that the current is turned off before making adjustments in the circuit.

23. Return all equipment, clean and in good condition, to the designated location at the end of the lab period.

24. Clean up your lab area at the conclusion of the laboratory period.

XIII. General Comments:

Withdrawal Policy: If a student withdraws from the lab course, appropriate forms must be submitted by the student to the Registrar's Office. Otherwise, the student will be kept on the lab roster and receive a grade for the course. Time restrictions and procedures for withdrawing from a course are found in the college calendar for the appropriate semester.

Academic Dishonesty Policy: Academic dishonesty will not be tolerated and will be subject to the appropriate penalties. Please make every effort to avoid dishonesty or the appearance of dishonesty in all course activities. Penalties may include, but not limited to a zero grade for the activity, failure in the course, or dismissal from the college.

Counseling: Students are encouraged to meet with the instructor to discuss any problems they are having with the course. While office hours have been set aside

for student discussions, any mutually agreeable time for a student-instructor meeting is satisfactory.

Disability Statement: Students in this lab course who have a disability that may prevent them from fully demonstrating their abilities should contact the instructor and special services as soon as possible to discuss accommodations necessary to complete the course requirements.

Cell Phones and Pagers: Cell phones and pagers are not allowed in the laboratory. If a student needs to be on a beeper (EMT for example) the pager should be set to vibration mode.

First Aid in the Laboratory

Type of Injury	First Aid
Burns	Immediately flush with cold water until burning sensation is lessened.
Cuts, bruises	Follow instructions in first aid kit. Do not touch an open wound without safety gloves. Pressing directly on minor cuts will stop bleeding in a few minutes. Apply cold compress to bruises to reduce swelling.
Fainting	Provide fresh air and have the person recline so that their head is lower than the rest of their body.
Eye injuries	Flush eye(s) immediately with plenty of water for several minutes. Use an eyewash fountain or bottle if available. If a foreign object is lodged in the eye, do not allow the eye to be rubbed.
Poisoning	Find out what substance was responsible for the poisoning and alert the instructor immediately.
Spills on the skin	Flush with large quantities of water. For acid spills apply baking soda solution. For base spills apply vinegar or boric acid.
Electrical shock	Shut off the current at the source. Remove wire with rubber gloves. Alert the instructor immediately.