Undergraduate Radiometry Laboratory

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1 Overview

The purpose of the Radiometry Laboratory class is to observe, measure, and quantify the principles and theories of radiation propagation that you learn in the Radiometry Lecture class. This experience should not only reinforce your understanding of radiometry, but give you hands-on experience deriving and verifying radiometric relations in a measurement environment.

Each week that a new lab experiment is started, the entire lab section will meet in room 76-3125 for a brief lecture regarding the experiment.

The Lab website is located at: http://www.cis.rit.edu/class/simg401/. Here you will find handouts and other material related to the lab.

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2 Lab Techniques and Safety

As a prerequisite for this course, you have taken an Optics class and have some experience with working in an optics laboratory. The same guidelines observed in an optical laboratory class should be observed in this one.

Any object which is meant to control how light is reflected or transmitted can be damaged severely if you touch it the wrong way. Do not directly touch the surface of any optical elements. If contact should accidentally occur, do not attempt to clean it yourself with your shirt sleeve or some other piece of fabric. Take the element to your Lab Instructor or Teaching Assistant.

A corollary to this rule is "don't place things on top of the optical elements or instruments." For example, don't let a neutral density (ND) filter get buried under books, papers or equipment. Never place filters on the bench in an unprotected manor. Never let anything come in contact with glass surfaces or lenses, etc.

The importance of optical alignment is very critical. If you have to move elements on the optical bench make sure that they are securely attached to the bench fixture and make sure the fixture is securely seated on the optical bench. If an element is accidentally "bumped", stop your series of measurements, verify your alignment, and repeat that series of measurements.

This is a radiation propagation laboratory and several types of light sources will be utilized during this course. Always follow these safety guidelines:

- Don't look directly into the beam of any light source and be aware of

stray reflections.

- Optical elements made from glass (lenses) can have sharp edges. Hold them carefully to avoid getting cut.
- Don't hold bare electrical wire or touch bare electrical connections!
- Most experiments will be done in the dark. Have a clean and organized work area to avoid hurting yourself and/or your lab partner(s).

3 Write-up Guidelines

Lab reports are meant to serve two primary purposes: (i) explain the purpose and procedures from experiment in such a way that the reader has a solid understanding of what knowledge your experiment sought and how you went about seeking it, and (ii) to explain the results of your experiment.

There are many specific formats that can be used to write a lab report. The following section describes the suggested format to use for reports prepared for this lab. The bulk of your text should be formatted in a clean, formal font at 11 or 12 point using single or 1 1/2 spacing. Section headers can be larger, bolded, etc. Headers, footers and margins should be around 1 in.

Lab write-ups are due at the beginning of each lab. In certain circumstances, they can be mailed to your lab TA for grading (see above email address). This may prove to be useful in the event that you have graphs or figures that take advantage of color and you do not have access to a color printer.

And finally, please do not hand in your labs late. Handing in a late lab with out a penalty, is not fair to the rest of the individuals in the group. Why should some people get more time to work on the lab than others? Be conscientious and considerate. :)

3.1 General Format

3.1.1 Title

This section should include the name of the lab, the lab number, your lab partners, lab section, meeting time and the date the experiment was performed.

3.1.2 Abstract

This should be a brief explanation of the lab, what the objectives of the experiment were and a brief summary of the results.

3.1.3 Procedure

This section should include a brief explanation of the procedures used in the experiment. This should not be written as a list of "steps" that were performed but rather a well worded paragraph or set of paragraphs that describe the experiment. Enough detail should be provided so that the reader can visualize the experiment but it does not need to be bogged down with "nitty gritty" details. For example, the gauge of wire that was used to build a circuit, or a precise measurement of distance do not need to be included here. These fine details are better suited for the Appendix section for someone who wants to reproduce your exact experiment.

3.1.4 Analysis

This is the most critical section of your lab write-up. The Analysis section should be where you describe the results of your experiment and what they mean. In many cases the experiments may be very straight forward to perform and the analysis of the data is the focus of the experiment. This section should spotlight your ability to make observations regarding your collected data and draw conclusions. Your observations should be clearly justified by your data. You should also describe any sources of error that may have affected the outcome of your experiment and (most importantly) how exactly that source of error affected your results (see more in the Section entitled "Other Suggestions".

This section may include data plots, line fits, comparisons to model data, illustrations, equations, etc.

3.1.5 Conclusions

The conclusions section should be a concise paragraph that describes the observations and conclusions that resulted from this experiment. You might also include Appendices.

3.1.6 Appendices

This section is reserved for any additional materials that you wish to include with your report. In most cases this will be where you include the raw data

collected in the experiment.

3.2 Other Suggestions

- The raw data that you collect is not meant to be a formal part of your lab write-up. Raw and processed data tables should be attached as appendices and referred to in your write-up.

- Don't make your plots 1 in by 2 in! Plots are meant to be readable but do not be printed landscape on a single page. The suggested size is 3 in by 5 in. This size should be the actual size of the plot and axis labels. Programs like Excel tend to automatically add lots of empty space around graphs and this should be corrected. The axes should be properly labeled and include units. If you have multiple lines in one plot, print using color or use unique series markers (squares, triangles, etc.) Make sure that the plot lines, tick marks, etc. are not so fat that the ability to use it as a source of data is impossible. Do not hand label your figures or tables. Do not hand write equations. You have access to modern publishing tools so use them.

- Entire MathCAD worksheets are not meant to be copied into lab reports. Cleanly formatted tables and graphs with legible labels are expected and are not what is commonly produced by MathCAD.

- You are expected to discuss sources of error in your experiment. Sources of error like "I might have recorded the values wrong" or "the plug may have fallen out of the wall" or other sources of human error should not occur and should not be discussed. If you can not make reliable measurements then you are a bad scientist.

- Describe sources of error such as limitations in the theories being used or in the instrument itself. For example, the variance in instrument readings can be considered a source of error. In these cases, it is required to discuss the effects of these errors on the experiment results. "The noise of the instrument can account for a variance of N units in the derived values". In the worst case, indicate that you can't quantify the affect of the error: "The source of this error is not understood and the affect on the results cannot be quantified."

- If you describe sources of error, be prepared to justify them. "The instrument is bad." is not a very useful observation. How is it "bad"?

If your suggested source of error can be verified with your data, then you better do so.

- If you identify a source of error you should try to indicate what could be done to minimize the impact of this source. For example, if your instrument was found to be "noisy" in some way, suggest methods to minimize the influence of noise on your results.

- If you fit your plot data and want to report the result, don't write sentences like: "The fitted equation for the data was y = 1.255x - 42.5 and the r-squared value was 0.9987". In most cases, the exact line equation is not important. The type of line that was fit is important. The "goodness of fit" is also important. Instead you usually want to write, "The data was found to fit to a linear equation with a 99.87 % accuracy."

- Your discussion is meant to be "explanatory" but don't make your language too casual. Make your comments concise and to the point without cutting out the detail of your point.