Physics 133 Report Guidelines

Your lab report should focus on the physics background involved in each lab, data taking procedures, error analyses, and conclusions drawn from the experiments. Please show the majority of your work for the error analysis. A suggested format is to quote the equation used and result in the body, and the main intermediate algebraic steps in the appendices. Data tables related to the analyses and discussions should be included in the text, while large (around ½ page) tables can be moved into the appendices and referenced.

Below are the required parts for each lab:

Lab 1: Linear Fits of Mystery Impedances (100 points total)

1. General (30 points):
    a. Title page with title, abstract, date, and contact info.
    b. Introduction: background, theory, and equations
    c. Apparatus and procedures: include any unique/custom software/instrumentation
    d. Results and discussion
    e. Conclusions
    f. References
    g. Appendix
2. DC voltage source (10 points): best fit line of I vs V. Determine output voltage and internal resistance.
3. Mystery boxes (45 points, 15 each): Pick A or B, C or D, and E (three total) For each:
    a. Determine the components and include a diagram of the circuit.
    b. State the corresponding impedance and phase equations.
    c. Calculate the parameters and their uncertainties for each component by performing a linear fit of the data. Show an impedance magnitude plot and phase plot with experimental data points and error bars, and a theoretical curve.
    d. Perform a chi-square test for the linear fits.
    e. Choose appropriate titles, axes, units, legends, and captions for each plot.
4. Nonlinear circuit elements (10 points): Show a drawing/plot of the IV curve for each diode. Discuss the threshold and breakdown (for Zener) voltages.

Lab 2: Atomic Spectroscopy (100 points total)

1. General (30 points): same as above
2. Helium experiment (30 points):
    a. Identify the wavelengths of 8 He lines (lab manual table)
    b. Record the undeflected angle, color, angle, and order
    c. Use a weighted average and its error to calculate the grating spacing d and its error. Show error propagation due to the error in the measurement of spectral lines' diffraction angles.
3. Hydrogen experiment (30 points):
    a. Record the central undeflected angle, color, angle, and order of each.
    b. Calculate the wavelengths of 4 H lines using the d you found.
    c. Determine the principal quantum numbers of each line.
    d. Use a weighted average and its error to calculate the Rydberg constant and its uncertainty.
4. Helium-neon LASER experiment (10 points):
    a. Discuss the simultaneous observation of the laser and neon lines. Determine whether the He or Ne is responsible for the laser's color. Find the wavelength of the laser's light.

Lab 3: Gamma Ray Lab (100 points total)

1. General (30 points): same as above
2. Plateau region experiment (5 points):
    a. Plot the plateau region, show counts vs applied high voltage, and the pulses' amplitude vs high voltage
3. Intrinsic C and R experiments (5 points):
    a. Calculate C, R, and Q (charge) by adding an external capacitor.
    b. Observe the change in pulses' amplitude and time constant by adding an external resistor.
4. Background counting rate (1 point): Record the background rate.
5. Investigate counting statistics (15 points): Fit 100 one-second interval counts to a Poisson distribution and do a chi-square test of the fit.
6. Dead time experiments (14 points): Measure the dead time by using both the direct and indirect methods. Compare the results.
7. Absorption of gamma rays by lead (30 points):
    a. Determine the absorption coefficient based on the shielding experiment
    b. Perform a chi-square test of the curve fitting (avoid introducing correlations to the data)
    c. Compare the experimentally obtained absorption coefficient with the theoretical value.