

**Course Description:**

The Junior Lab 307L is a laboratory course with experiments in modern physics for advanced undergraduate students. Students will obtain expertise in laboratory equipment, data analysis, and error analysis and in writing formal reports in a scientific format. The course consists of one lecture per week, on Monday from 13:00-13:50, and one 3-hour lab session per week, either on Monday from 14:00-16:50 or on Wednesday from 14:20-17:10.

For this course you will need to complete 6 experiments chosen from the list below plus the oscilloscope experiment, which is mandatory. For the experiments, you will use the guides from the Junior Lab manual from Prof. Michael Gold: [Lab Manual](#). The guides for the experiments to be followed are:

[The Oscilloscope](#)

[The e/m ratio for Electron](#)

[Electron Diffraction](#)

[Balmer Series](#)

[Planck's Constant](#)

[Excitation and Ionization Energies of Neon](#)

[Electron Spin Resonance](#)

[Poisson Statistics](#)

[Mass of the Electron](#)

[The Speed of Light  \$c\$](#)

[Charge of the Electron](#)

**Notebook:**

You must have two laboratory notebooks; one will be used for laboratory work while the other one is being graded. Your lab notebook must include a complete description of each experiment you perform, the methodology for acquiring data, and the analysis of the results.

More specifically, for each experiment, the notebook must have a brief description of the theoretical background and the purpose of the experiment, and a clear description of the experimental procedure used to take data. It should include schematics of the experiment and other relevant diagrams.

The experimental data should include units. Graphs, when required as part of a particular experiment, must have axes properly labeled. You must also include explanations and equations that may be necessary to understand each graph.

The analysis of the data must include error analysis and a description of how this analysis was done. The final results must be reported with total errors, and they should be compared with the expected (accepted) values. Discuss any discrepancy of the final results with expected values.

Answer all questions from the experiment guide, and complete all the parts of the experiment.

Notebooks must be written in ink, and do not tear out pages. Cross out pages or sections of the pages that are not to be taken into account (this will not be reviewed).

### **Homework:**

During the semester there will be a few assignments related to error analysis, data analysis and presentation of results.

### **Presentation**

At the end of the semester, each student will give a short presentation about an experiment (10 minutes). After each presentation, there will be a short time for questions.

### **Formal Reports**

You must write three formal reports from the experiments that you perform in the laboratory. Here is a guide for the formal lab reports: [Guide Lab Reports](#). The lab reports need to be typed and submitted as a word or PDF document, including graphs and relevant diagrams. Here is an example from a former student: [Example Report](#). Published physics papers such as in [Physical Review Letters](#), [Optics letters](#), etc. may also provide a guide.

Submit the formal lab reports by email ([fbecerra@unm.edu](mailto:fbecerra@unm.edu)) with the subject "Lab Report #" followed by the number of the lab report: 1, 2 or 3. The name of the files should be your last name followed by the name of the experiment. Lab report #1 will be reviewed and returned to you to make revisions. You will resubmit the revised lab report two weeks later.

### **Grades**

<b>Lab Notebook</b>	<b>40%</b>
<b>3 Formal Reports</b>	<b>40%</b>
<b>Homework</b>	<b>10%</b>
<b>Oral Presentation</b>	<b>10%</b>
<b>Total</b>	<b>100%</b>

Here you can find the [presentation](#) of the first class.

## Important dates

- **Three revisions of lab notebook**
  - First revision on 09/25/13.
  - Second revision on 10/30/13.
  - Third revision on 12/04/13.
- **Due dates for three formal reports**
  - First Lab report due 09/25/13, and resubmission in 10/15/13.
  - Second report due 10/30/13.
  - Third report due 12/04/13.
- **Oral presentations at the end of the semester** (*during lectures or Lab sessions to be determined*)

## Notes about some of the classes

[Fit a line with MLE](#)

[Bias of an estimator](#)

Some examples of programs for fit a line and nonlinear fit.

[Fit a line with matlab](#)

[Fit a nonlinear function with matlab](#)

[Poisson Statistics](#)