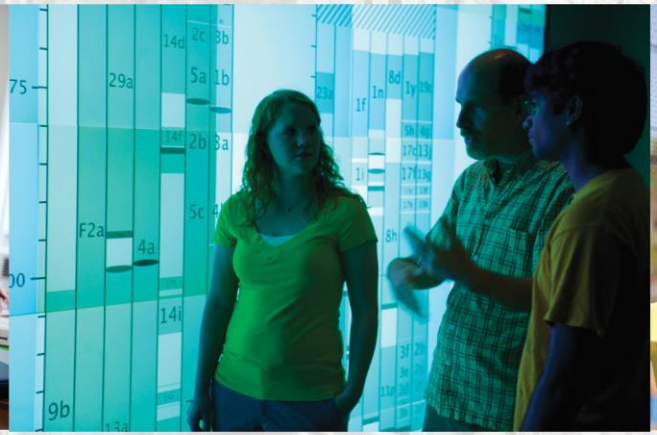
UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

Physics 401. Classical Physics Laboratory.

Fall 2016.

Eugene V. Colla

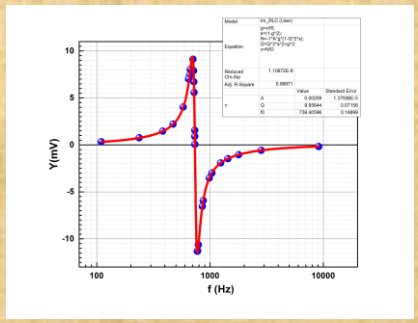


Physics 401. Spring 2014

- Course Objective
- Organization
  - Times and locations
  - Physics 401 staff
- Semester Schedule
- Laboratory routine
- Grading scheme
- Section assignments
- Comments

Classical Physics Lab.
Main Goals of the Course.

- ✓ Taking Data using modern equipment
- ✓ Data analysis
- ✓ Documenting of the experiment
- ✓ Presenting the results



Course Objective.

- ✓ Lectures
- ✓ Laboratory section
- ✓ Laboratory notebook
- ✓ Laboratory report

Course Objective. *Lectures*

Lecture attendance is not an optional part of the course but a sort of assignment - each lecture corresponds to *5 credit points*.

Course Objective. *Lectures*

Lectures:

Lectures will cover the idea of experiment, measuring approach, used equipment, possible analysis of the results, presentation of data, error analysis.

***Typical lecture plan*:**

- **briefly about physics of the experiment**
- **Experimental setup and equipment**
- **How to do the experiment, possible problems and difficulties**
- **Data analysis using Origin and data presentation**
- **Error analysis**
- **Questions, discussion**

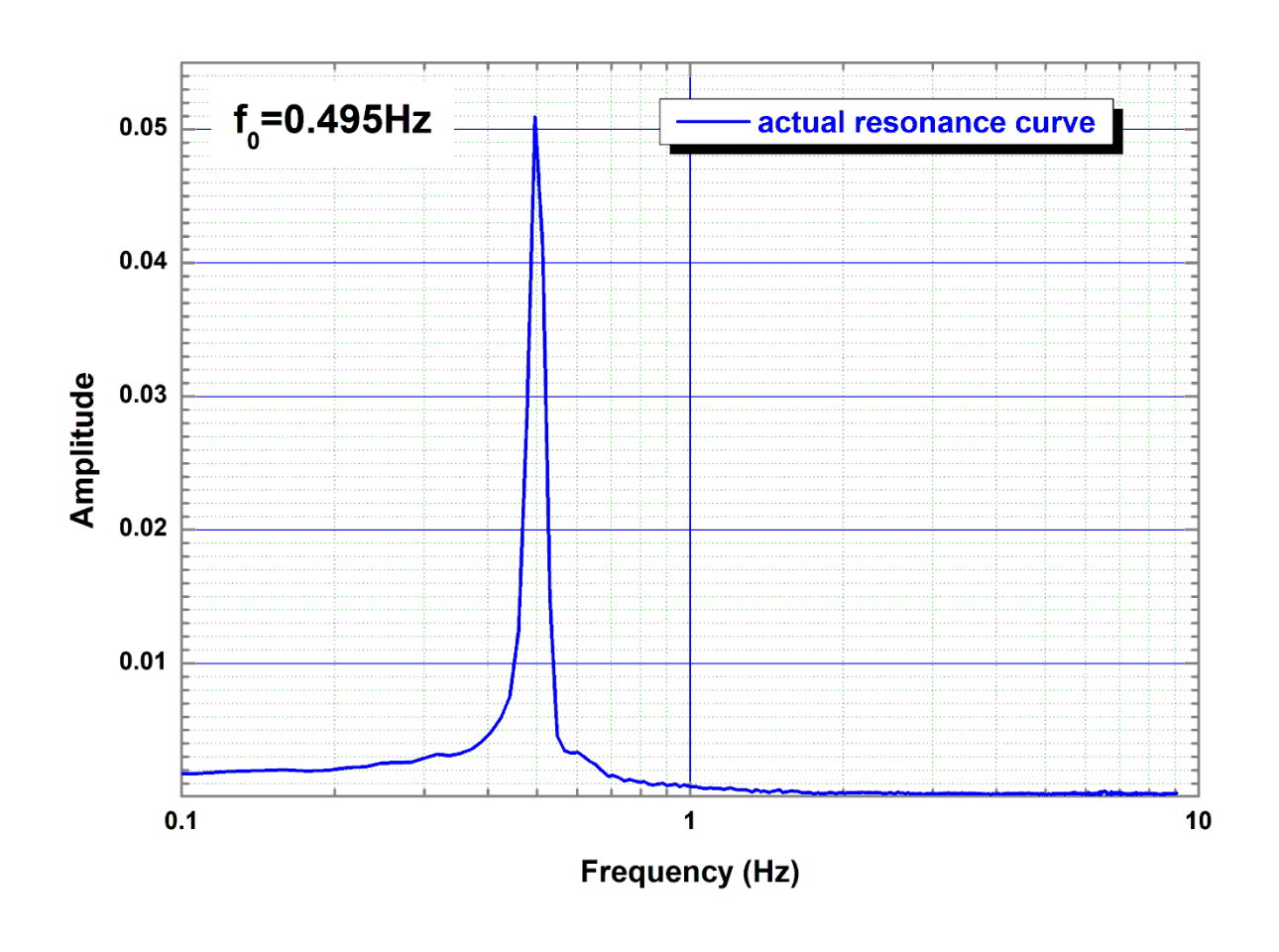
Course Objective. *Lab section*

Laboratory section:

Carry out experiment, briefly summarize experimental procedures and record observations and results in your laboratory notebook, *carry out preliminary data analysis* (*see comments in next slide!*).

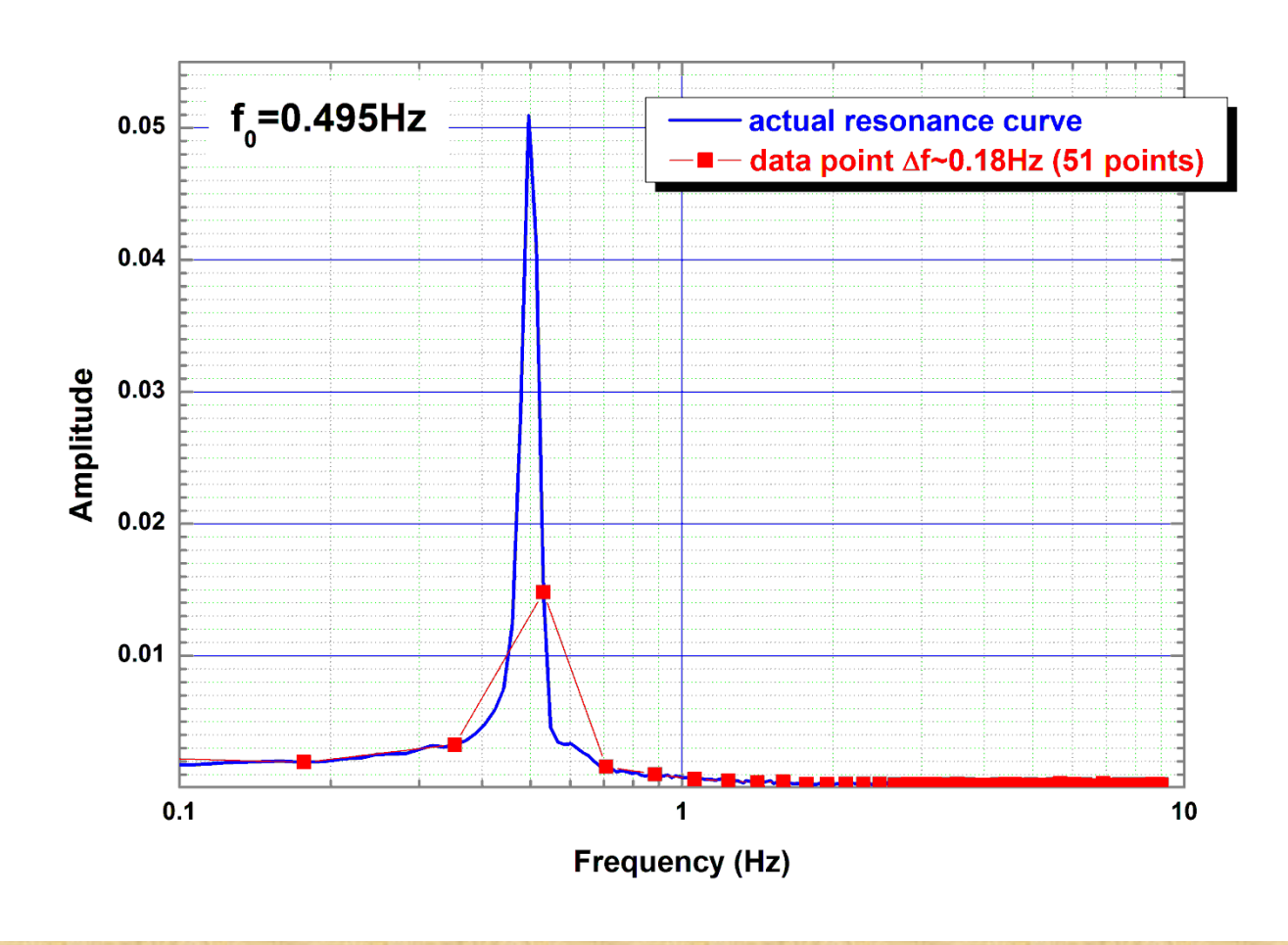
Course Objective. *Lab section.*

…carry out preliminary data analysis… do it in the Lab



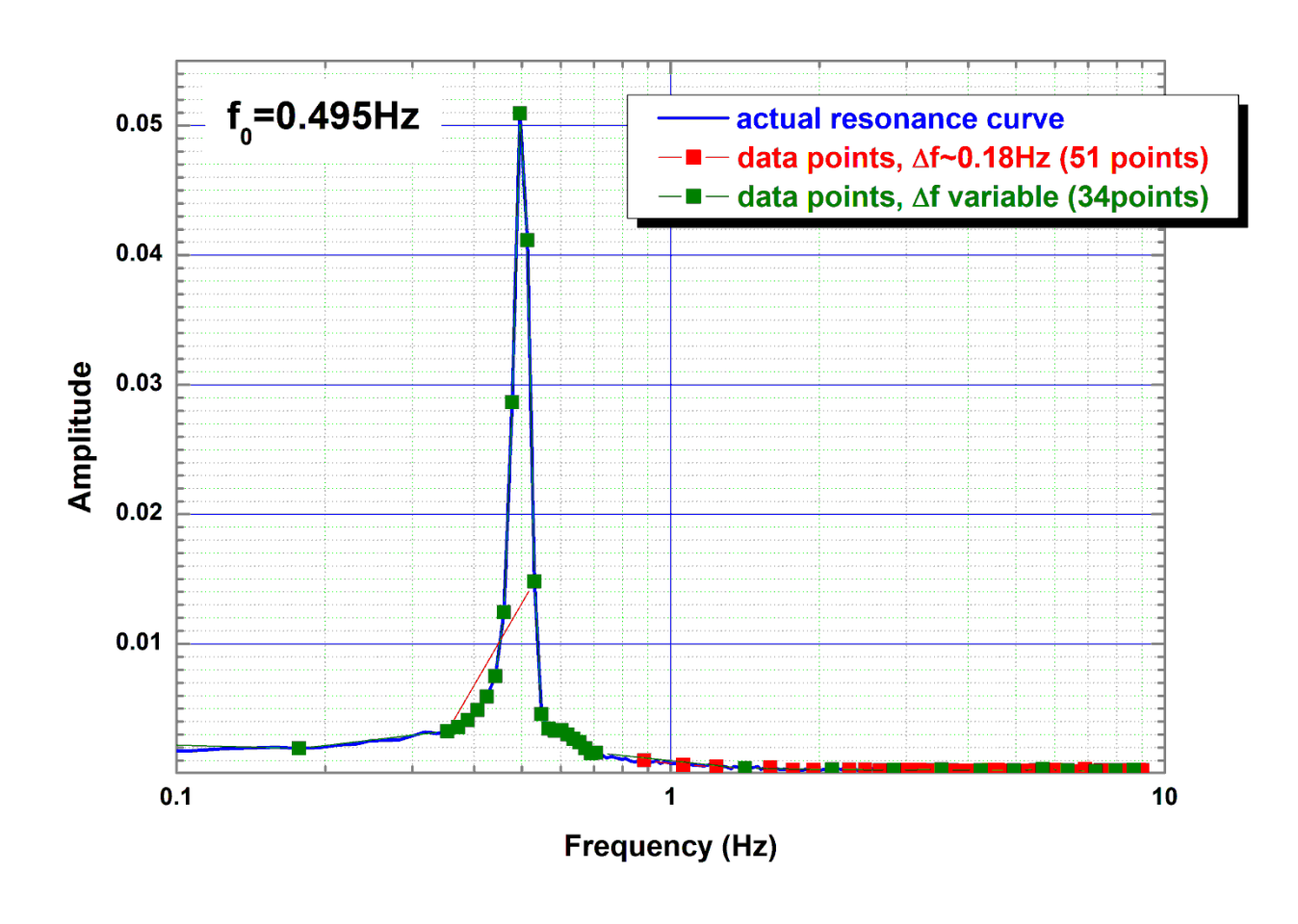
Course Objective. *Lab section.*

…carry out preliminary data analysis…



Course Objective. *Lab section.*

…carry out preliminary data analysis…



Course Objective. *Lab notebook*

Laboratory notebook:

You should have *two* notebooks. Both are identical. One will be submitted with report and the second will be with you to work on next experiment.

Course Objective. *Lab notebook*

Your laboratory notebook is the scientific record of your experiment. It needs to contain in brief all information required to solidly connect the experimental data with physics observables in the data analysis:

- ✓ **drawing of the setup,**
- ✓ **environment conditions (as needed)**
- ✓ **dimensions or other characteristics of experimental equipment relevant to later analysis**
- ✓ **results from calibration procedures**
- ✓ **data and error estimate**
- ✓ **some preliminary results and graphs**

Course Objective. *Lab report*

The main goal of the Lab report is to show the main results and findings of the experiment and how these results were obtained.

Laboratory report:

Report should be submitted electronically not later than a week after the Lab was done. Despite you doing experiments in team of two each student should write a *personal report.*

Course Objective. *Lab report*

The components of the report. Title etc.

Title

Name

Affiliation, date etc.

Abstract

Measurement of the Electronic Charge by the Oil Drop Method

Excellent Student

TA: TA's name

Department of Physics, University of Illinois Urbana-Champaign

September 27 and October 4, 2012

Lab Notebook #1 Pages 10-12

Abstract

The Millikan oil drop method is used to determine the electron charge. Using a special scope aligned with a capacitor, the response of charged oil drops introduced into the capacitor through an atomizer is studied for each drop's rise in the presence of an electric field and fall without the field. The rise and fall times, when applied to several equations along with various environmental constants, give the total charge on the drop. These charge values are then studied using a histogram, and by analyzing fit peaks, mean charge values for the distribution are obtained. These mean values, compared to the previously obtained total charges, allow the estimated charge of the electron to be found. This process is completed for both an individual set of data and data collected by the whole section, the accuracy of the final results is then compared with each other and the theoretical charge on the electron.

Course Objective. *Lab report*

The components of the report. Abstract

Abstract

Several ferromagnetic samples were examined by probing with an external magnetic field to observe their susceptibility and phase change as we reoriented their magnetic spin. For each sample we recorded its behavior between its permeability and current driving the external field, the samples magnetic field and the external magnetic field, and the energy dissipated per cycle of reorientation. Further, the behavior or ferromagnetic samples under varying temperature was observed and through experimentation we derived one samples Curie temperature. For accuracy, we compared each sample to provided material for each species of magnet generally found from manufactures websites.

Course Objective. *Lab report*

The components of the report. Introduction

3. Introduction (Theory, motivation)

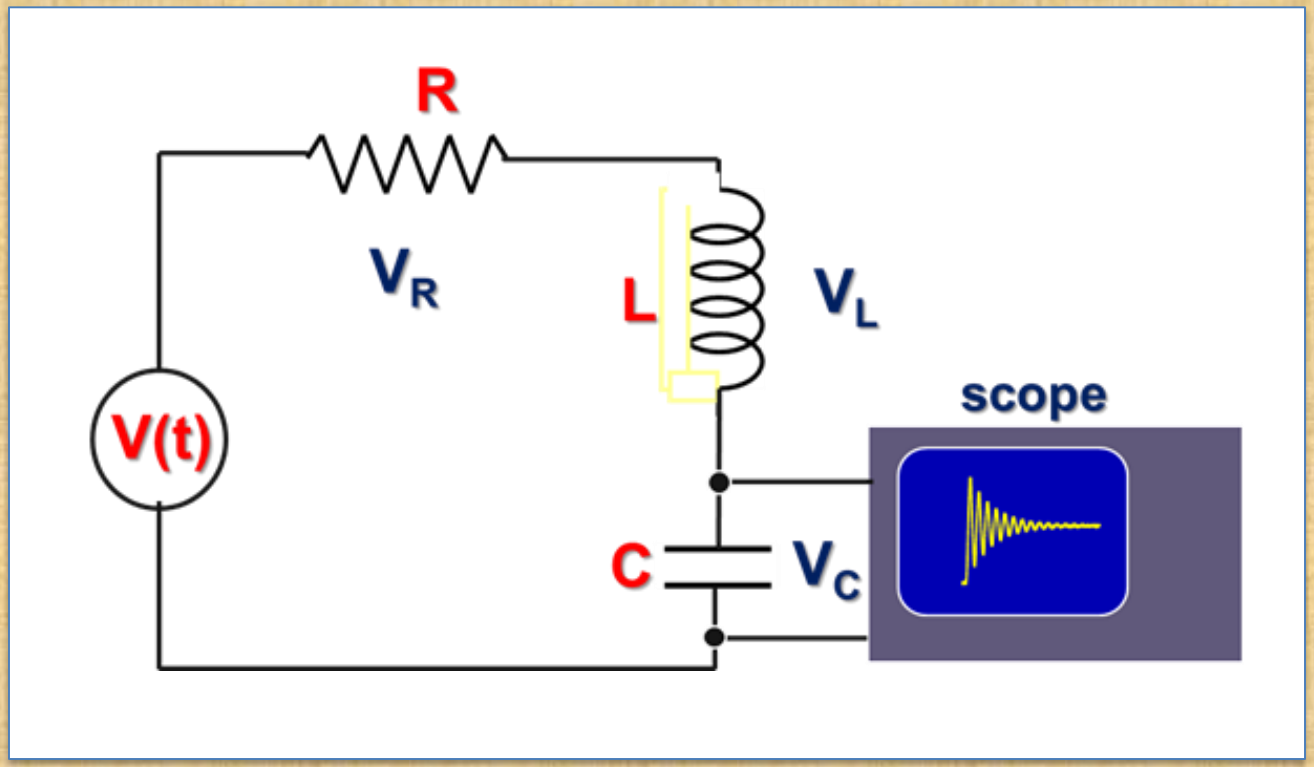
Introduction

Liquid Helium has very unique properties when cooled to temperatures below 2.17K and the pressure is lowered below 37.77 torr, which is known as the lambda point. It changes to a new phase of matter called He II. He II has several unique properties that distinguish it form normal liquid Helium or He I. These properties include zero viscosity while flowing through very small tubes, flowing without friction up containers walls and a thermal resistivity that goes to zero as the temperature goes to zero. All of this results in heat traveling in high speed waves, in contrast to ordinary heat travel through diffusion. The speed of these waves is called second sound, the name will become more apparent shortly. It also exhibits He I properties as a torsion pendulum with slowly decay showing the viscosity is about one-tenth of air. This viscosity paradox would be explained by Lazlo Tisza in 1938 with the formation of the two-fluid model. This model explains the properties of He II by letting the He II be a mixture of both normal liquid helium and superfluid helium.

Course Objective. *Lab report*

The components of the report. Procedure

4. Procedure (Setup, Measuring technique, Object of study)



Course Objective. *Lab report*

The components of the report. Results

5. Results (main finding, analysis, errors)

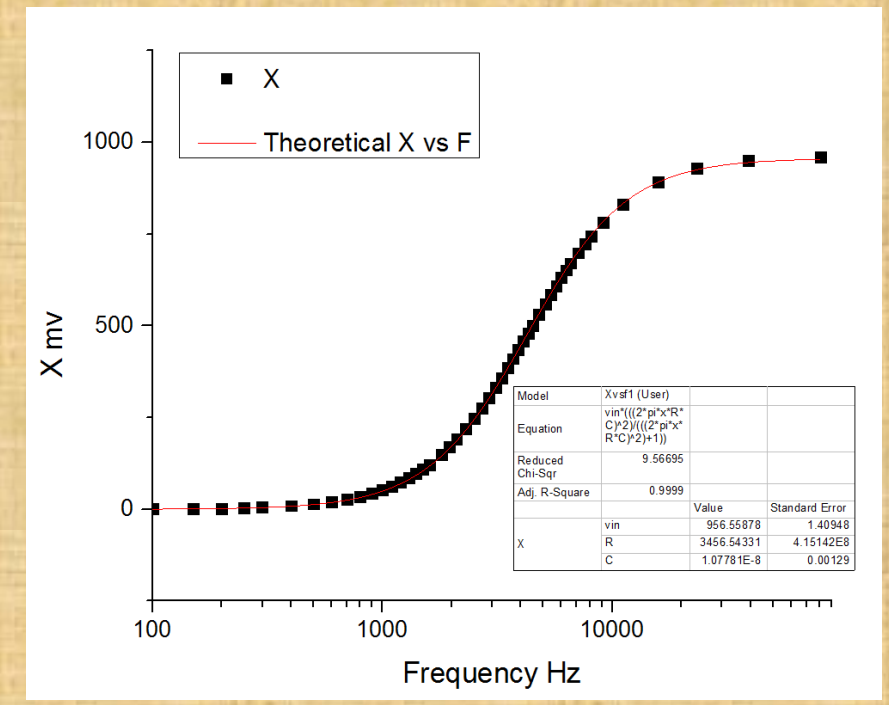


Figure 4. Graph of X vs Frequency over a wide range of frequencies in circuit A

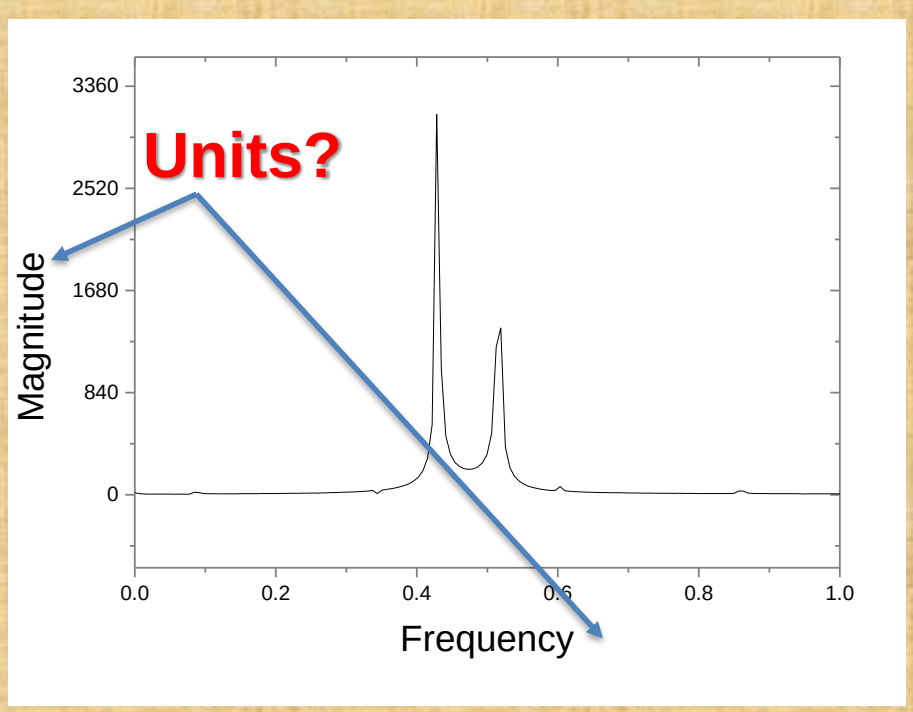


Figure caption ?

Course Objective. *Lab report*

The components of the report. Conclusions

6. Conclusions

In conclusion, a number of results were confirmed by oscillating a copper disk with different damping forces as well as different driving forces. The K value for static measurements produced a sheer modulus value within 3% of the handbook value. Using dynamic measurements the same k was calculated but there was a 17% error between the two, which was most likely due to human error in the static measurements experiment because there was so much hands on activity. No linear correlation for amplitude vs. log decrement for turbulent damping was found, which is due to the fact that the starting position of the disk was not far back enough. Using driven oscillation beats were observed. The amplitude and phase of damped, driven oscillator vs. frequency were also graphed.

Course Objective. *Lab report*

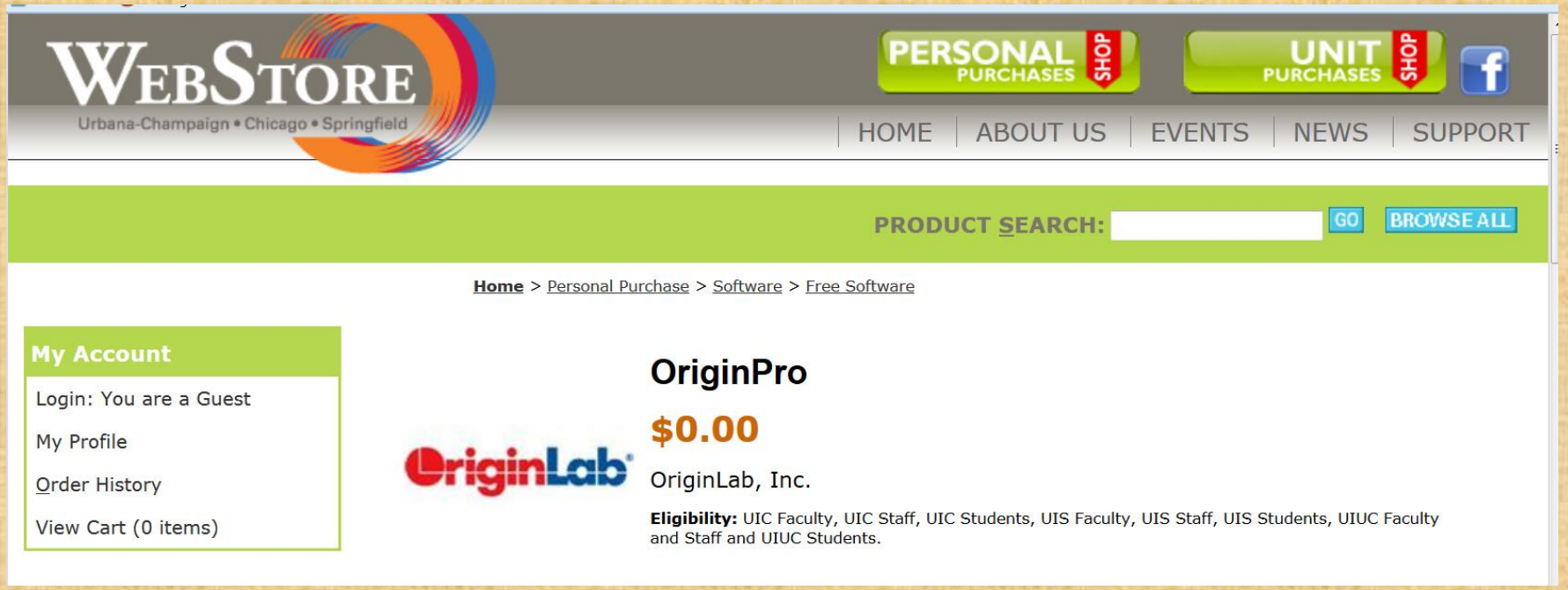
Some examples of reports from P401 and P403 could be found in:

\\engr-file-03\PHYINST\APL Courses\PHYCS401\Common\Sample reports - DO NOT DISTRIBUTE

Course Objective. *Lab report*

Graphs, graphical software

Origin can be used for data analysis and data presentation. There is 2016 version available on all Lab computers

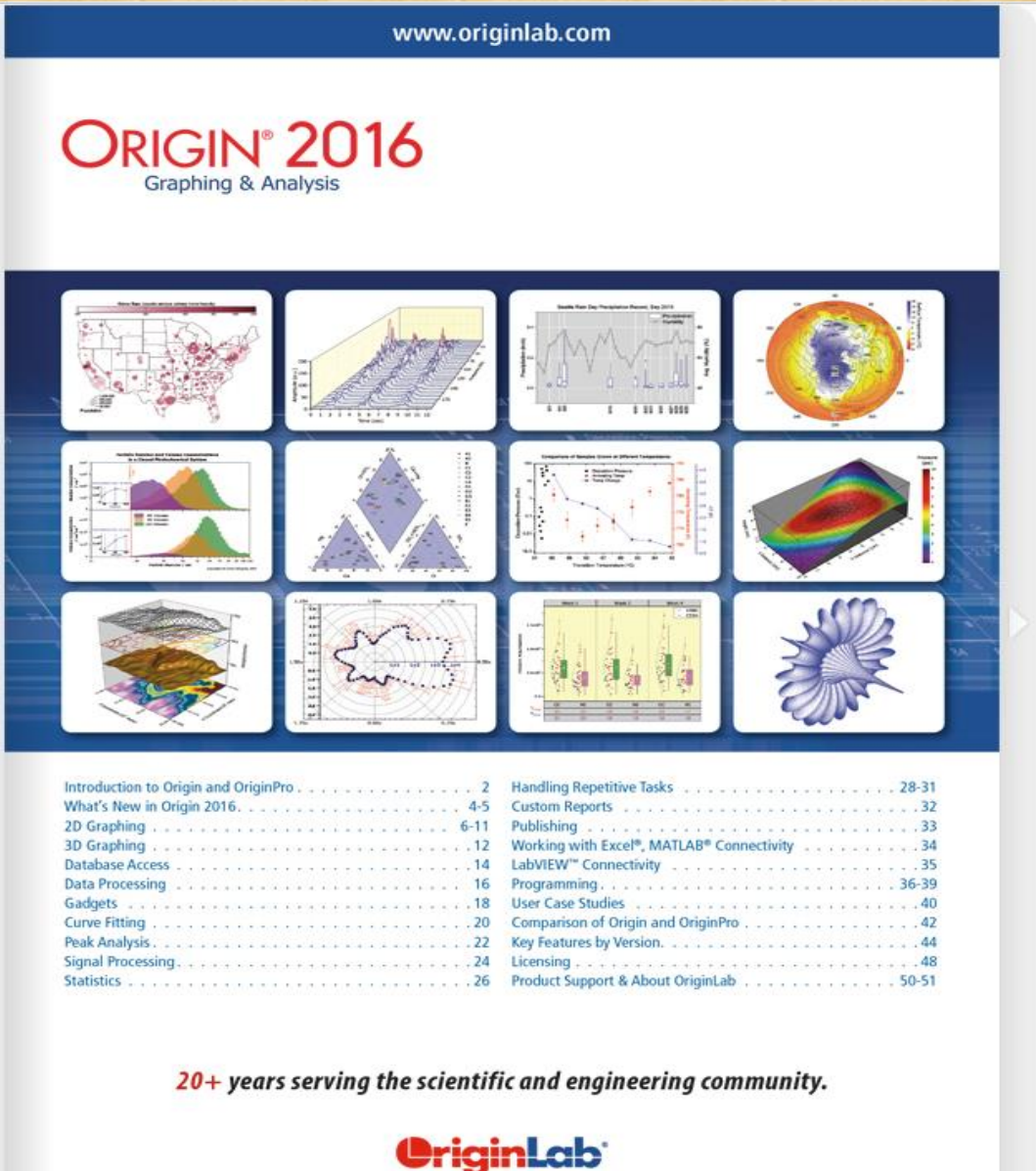


https://webstore.illinois.edu/Shop/product.aspx?zpid=1311

Course Objective. *Lab report*

Graphs, graphical software

OriginLab has put together a handy multi-page booklet highlighting key features of Origin and OriginPro. An online version of this booklet is available here: http://www.originlab.com/Booklet/



Course Objective. *Lab report*

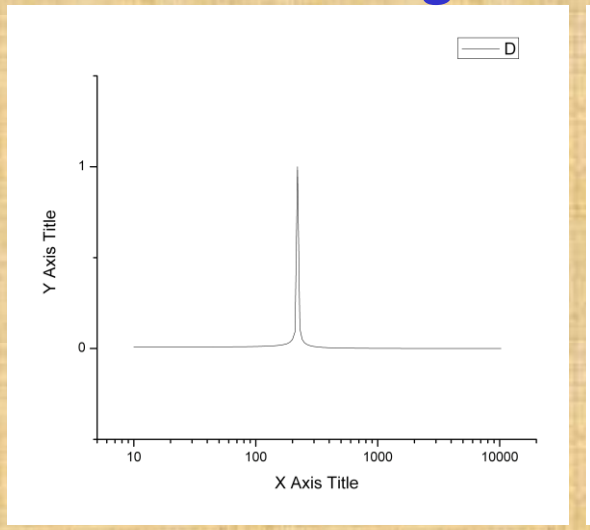
Graphs, graphical software

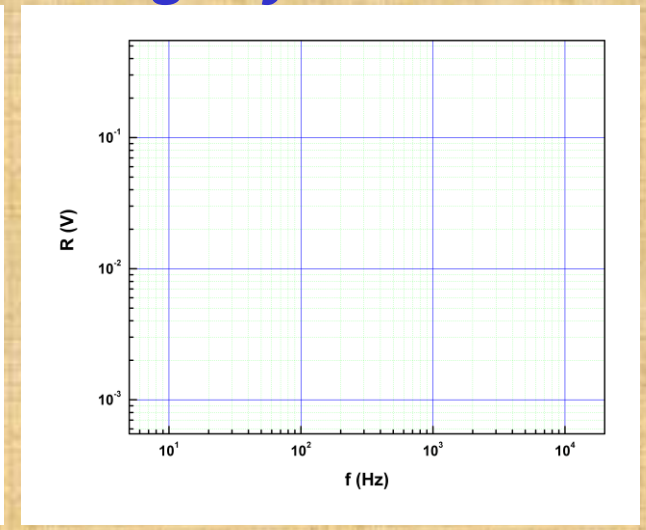
http://www.originlab.com/

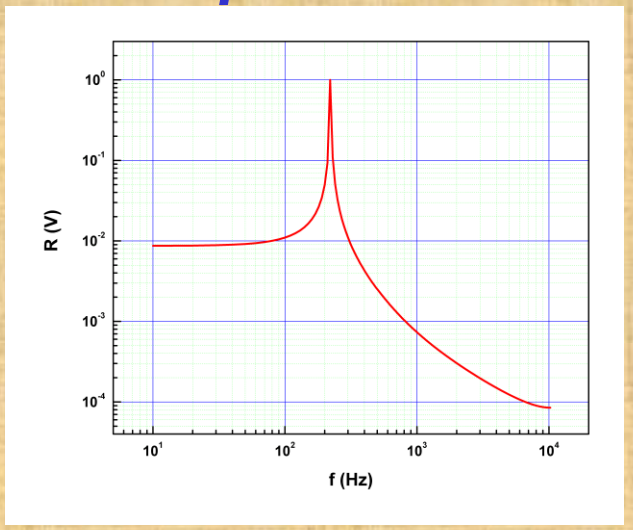
Course Objective. *Lab report*

Graphs, graphical software

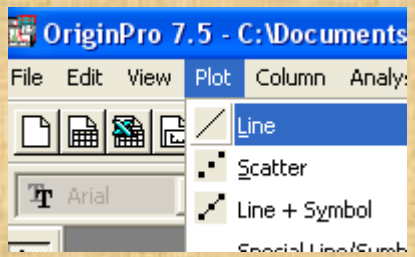
Working with Origin you can use the templates



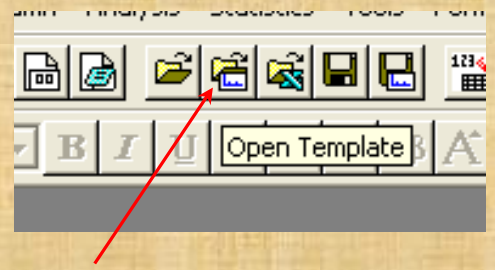




Simply plotting the data



Open the template



\\engr-file-03\phyinst\APL Courses\PHYCS401\Common\Origin templates

Course Objective. *Lab report. Submission*

The reports should be uploaded to the server:

https://my.physics.illinois.edu/courses/upload/

All assignments have the names close to the Lab Title

Frequency Domain Analysis Report_L1

Your Lab section

The acceptable file formats are: doc, docx, pdf

Be careful with assignment name and your Lab section selection!

Course Objective. *Lab report*

Deadline for notebook and lab-reports is the day (up to midnight) of each lab-section one week later. You have *two vouchers* to return the report by one week later with no penalty.

Voucher I to turn in notebook + report one week late.

Date:
Experiment No.:
Student Name:
Signature:

void after December 10 2015

Voucher I to turn in notebook + report one week late.

Date:
Experiment No.:
Student Name:
Signature:

void after December 10 2015

Course Objective. *Lab report*

All experiments will be performed in team of two, but the report should be written by each student *personally* using results of *personal analysis* of data and *personal graphs*.

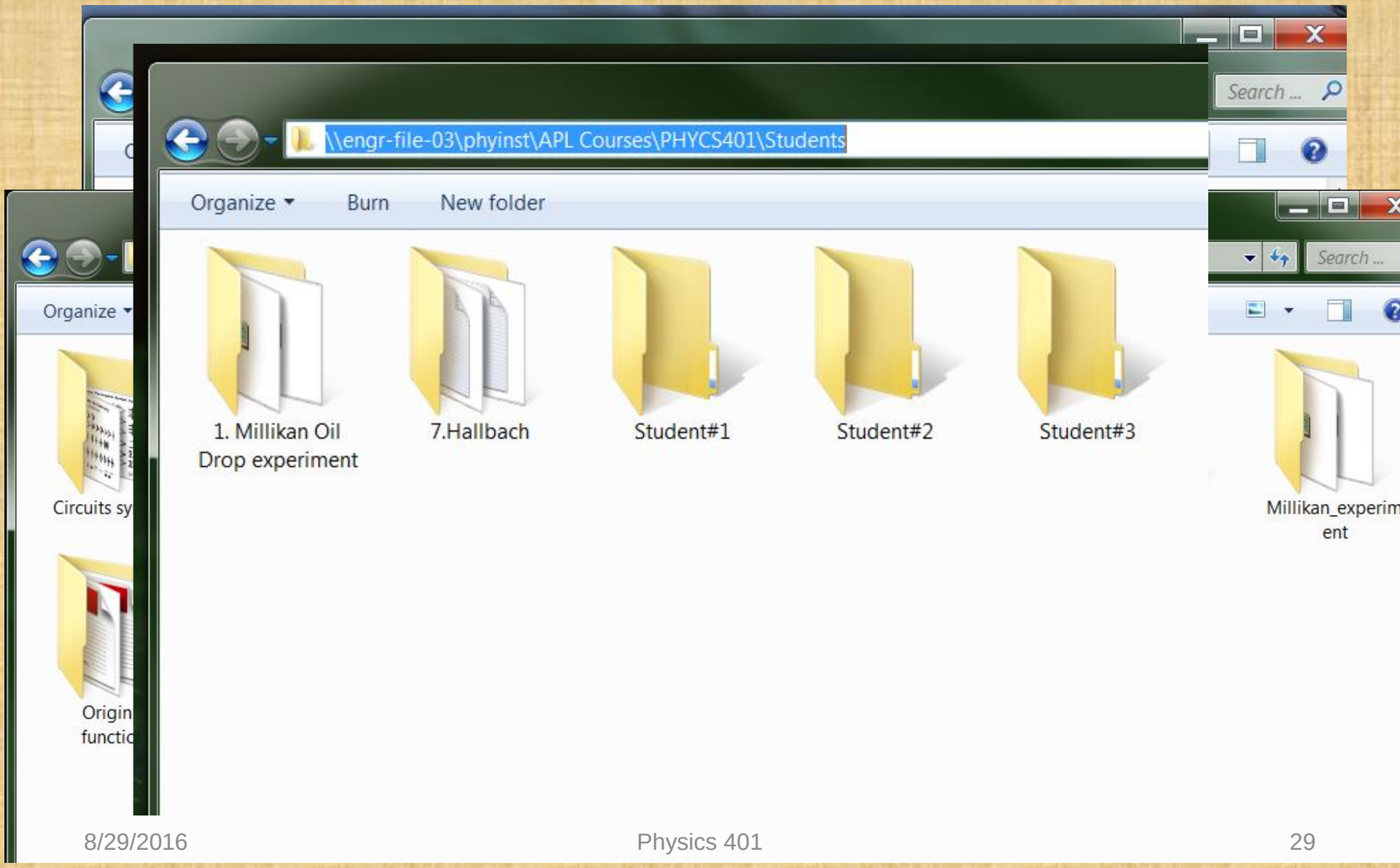
Course Objective. *Absences/Late reports*

In the case if you have acceptable reason for absence of the Lab section you have to contact Eugene Colla and we will try to figure out how to make up the Lab.

The rules for late reports:

- **5% of total score for report for up to 1 week late.**
- **10% - for up to 2 weeks late.**
- **After that, it's too late.**
- **December 14th is the final deadline for everything**

Computer Access in P401



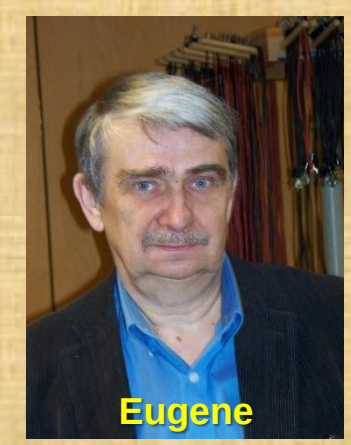
Typical Lab Routine

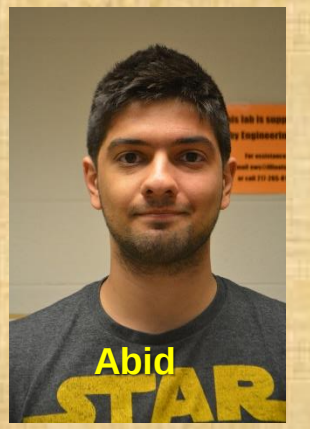
1. Reading the write-up (*better before the Lab session*)
2. Assembling the experimental setup. Drawing the diagram if it is necessary.
3. Taking data. Saving data using DAQ or writing manually the numbers in the notebook. In the case if data was obtained automatically you have to write in logbook the filename and its location.
4. Preliminary analyzing the data. Correcting the experiment settings if it is necessary.
5. Writing the report.

Times and Locations

Section	Type	Times	Days	Location
A	Lecture	03:30 PM - 04:20 PM	Monday	276 Loomis Laboratory
L1	Lab	01:00 PM - 04:50 PM	Tuesday	6103 ESB
L3	Lab	01:00 PM - 04:50 PM	Wednesday	6103 ESB
L3	Lab	08:00 AM - 11:50 AM	Thursday	6103 ESB
L4	Lab	01:00 PM - 04:50 PM	Thursday	6103 ESB

Physics 401 staff





	Name	Office Hours	Phone	e-mail
Lecturer	Prof. Eugene Colla	Monday 4:30-5:30 pm ESB 4137	office: 333-5772	kolla@illinois.edu
Laboratory Instructor	Hryhoriy Polshyn	Tuesday 12pm-1pm ESB 6103		polshyn1@illinois.edu
Laboratory Instructor	Chong Han	Friday 10am-11am ESB 6103		chan104@illinois.edu
Laboratory Instructor	Abid Khan	Wednesday 11am-12pm ESB 6103		aakhan3@illinois.edu
Laboratory Technician	Jack Boparai ESB 6101	None	office: 333-2208	jboparai@illinois.edu

Semester Schedule

Week of	No. Weeks	Lab Title	Point Value
August 22	1	Introduction to Classical Physics (P401) Course.	---
August 29	1	*Transients in RLC circuits*	50
September 5	1	*Frequency domain analysis of linear circuits using synchronous detection. (No Lecture this week - Labor Day Holiday)*	100
September 12	1	*Pulses in transmission lines*	100
September 19	1 of 2	*Millikan Oil Drop Experiment / Week 1*	---
September 26	2 of 2	*Millikan Oil Drop Experiment / Week 2*	100
October 3	1 of 2	*Torsion Oscillator / Week 1*	---
October 10	2 of 2	*Torsion Oscillator / Week 2*	100
October 17	1	*Hall Probe Measurement of Magnetic Fields*	100
October 24	1 of 2	*Qualitative Studies with Microwaves / Week 1*	---
October 31	2 of 2	*Microwave Cavities / Week 2*	150
November 7	1 of 3	*Final Project - AC Measurement of Magnetic Susceptibility / Week 1*	---
November 14	2 of 3	*Final Project - AC Measurement of Magnetic Susceptibility / Week 2*	
November 21		*Thanksgiving break*	
November 28	3 of 3	*Final Project - AC Measurement of Magnetic Susceptibility / Week 3.*	300
December 5	-	*No lab.*	
December 12		*Final week: Final Project Reports due on December 14th at 11:59 PM.*	Total 1000

Grading

Total Points(max) =

1000(reports) +

60(Lectures attendance)

Letter grading scale is approximately: 97% = A+, 93% = A, 90% = A-,

87% = B+, 83% = B, 80% = B-, 77%=C+, 73%=C, 70%=C-.67%=D+,

63%=D, 60%=D-