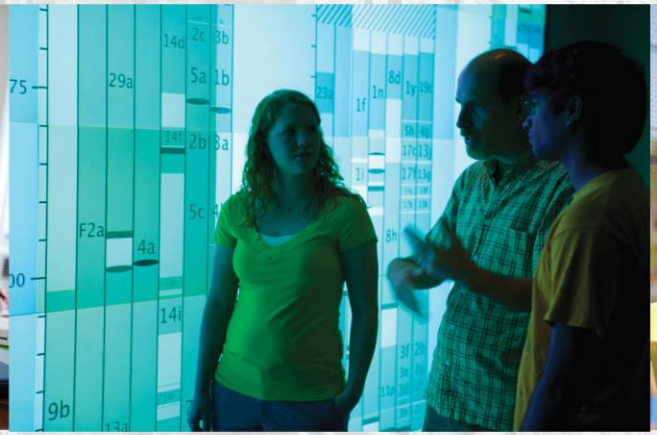
UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

Physics 401. Classical Physics Laboratory.

Fall 2019

Eugene V Colla

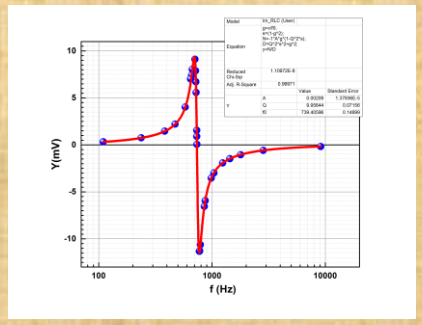


Physics 401. Spring 2017

- 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**

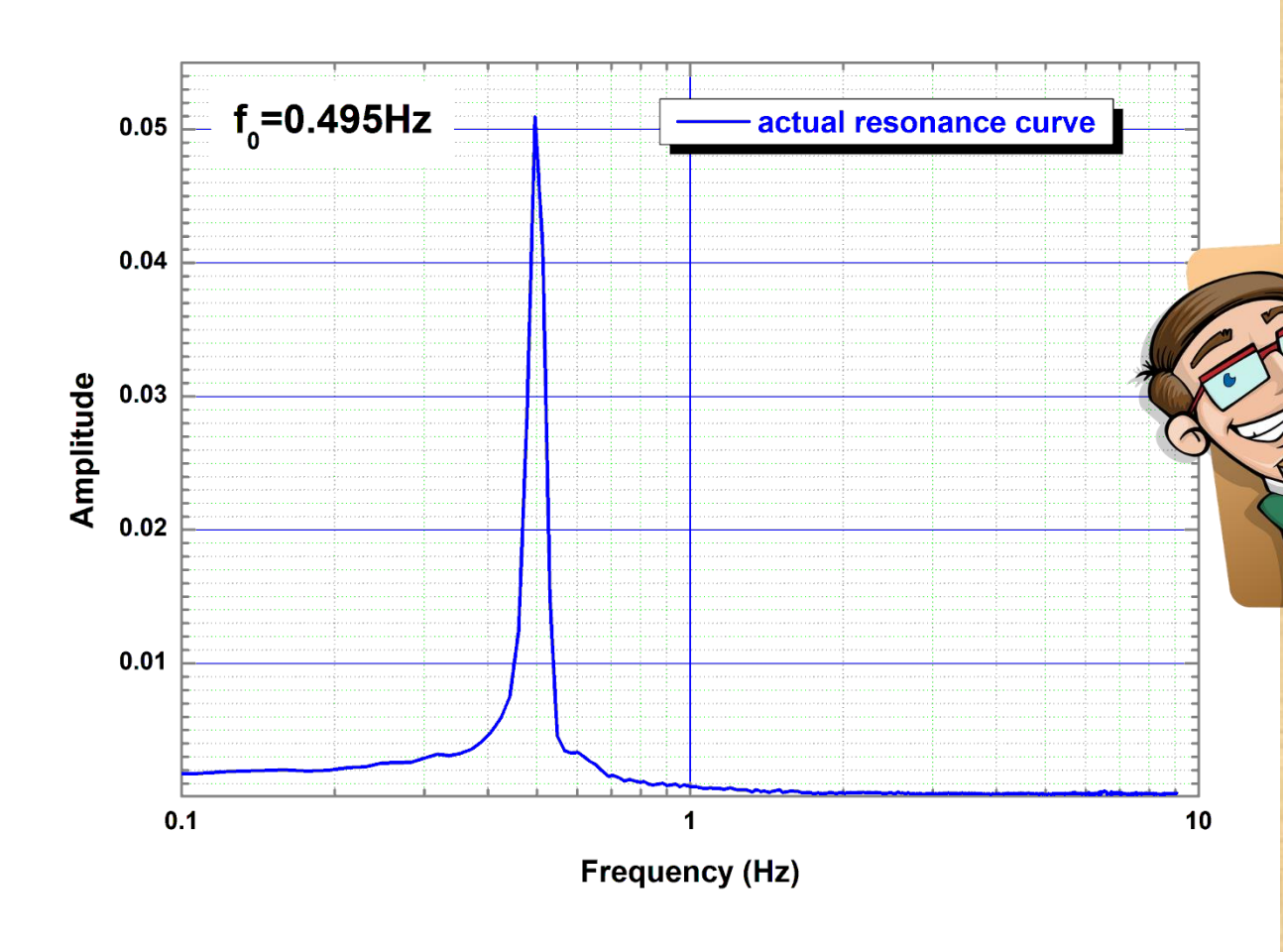
Course Objective. *Lab section*

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!).*

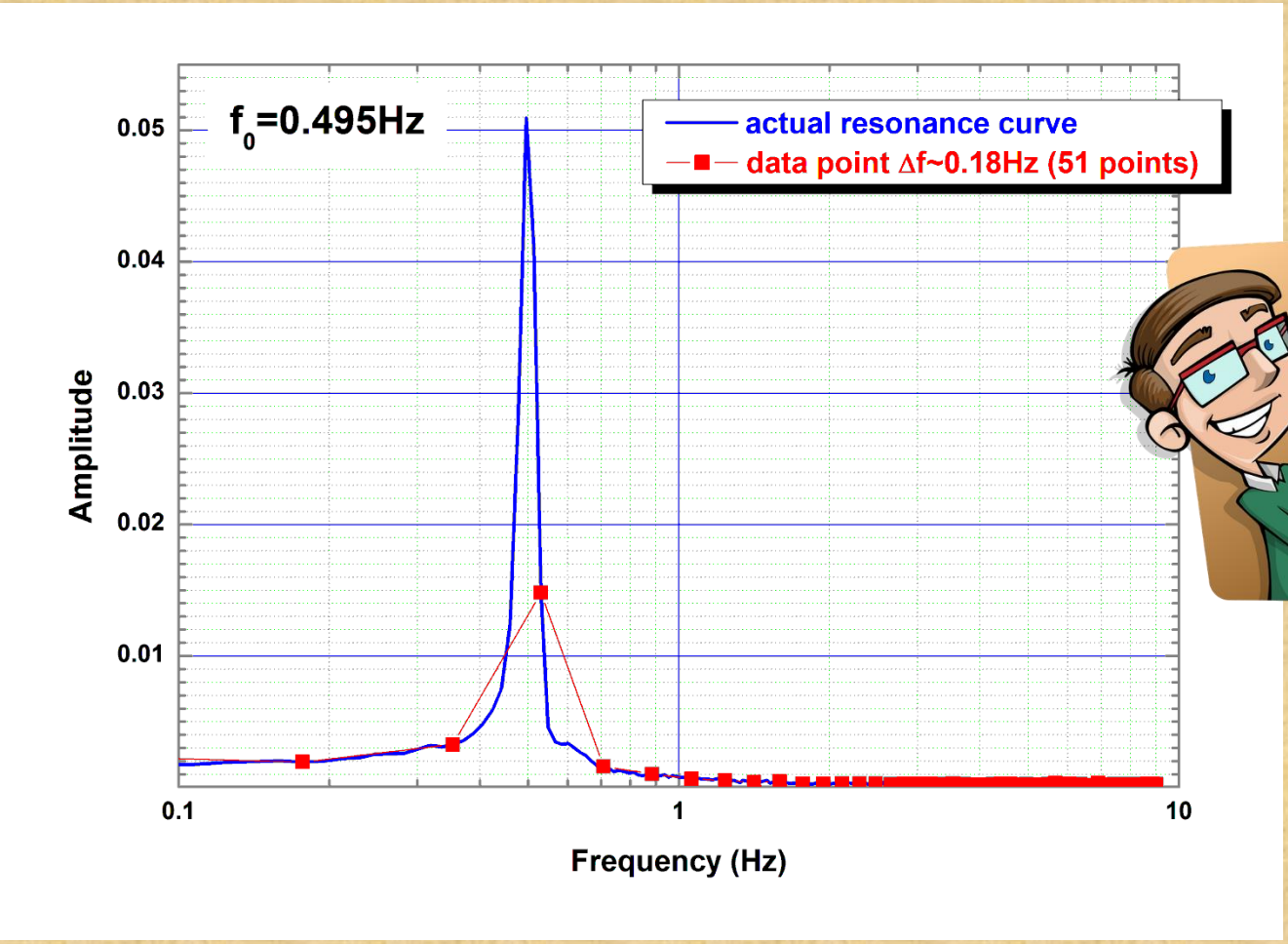
Course Objective. *Lab section.*

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



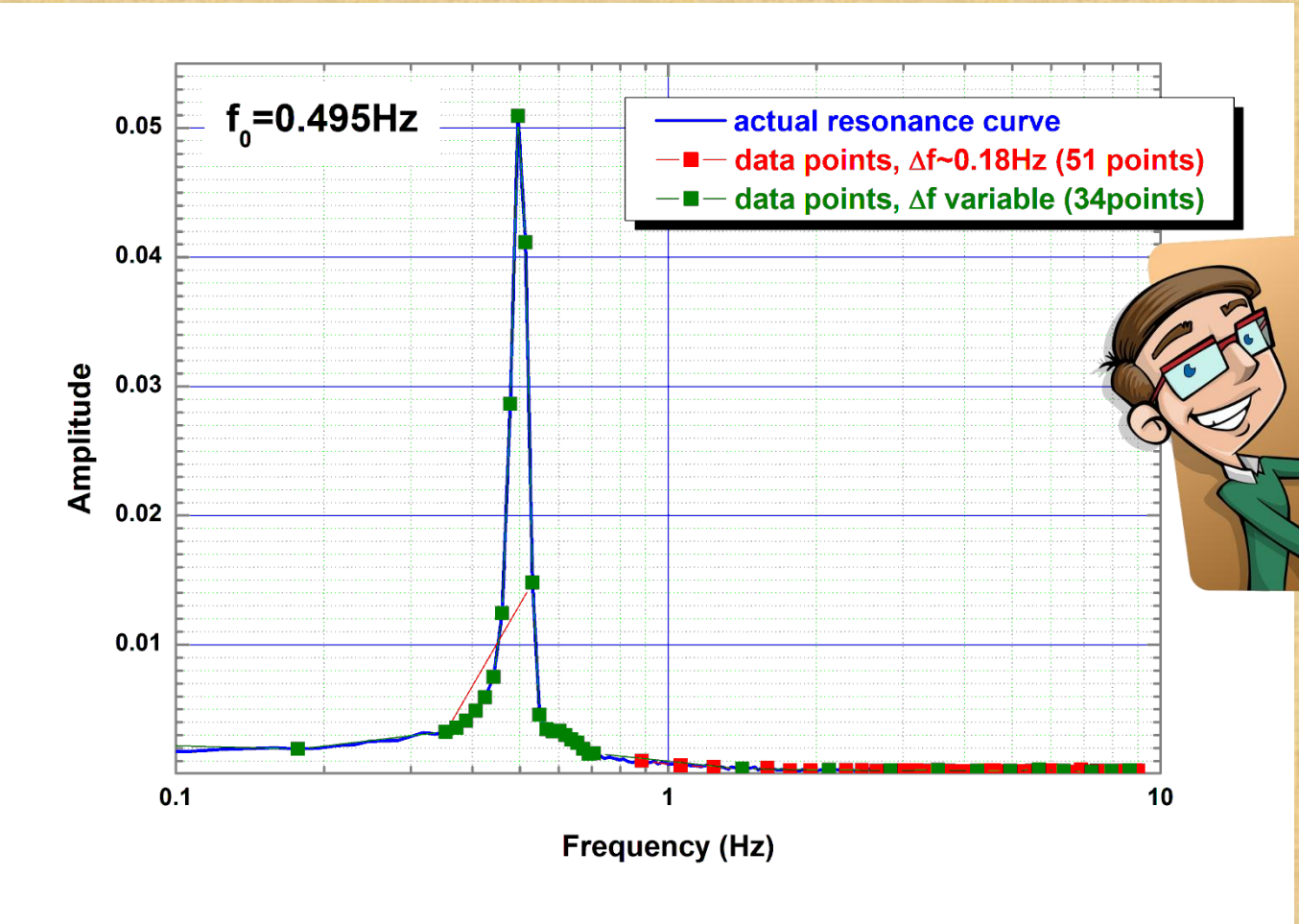
Course Objective. *Lab section.*

…carry out preliminary data analysis…



Course Objective. *Lab section.*

…carry out preliminary data analysis…



Course Objective. *Lab notebook*

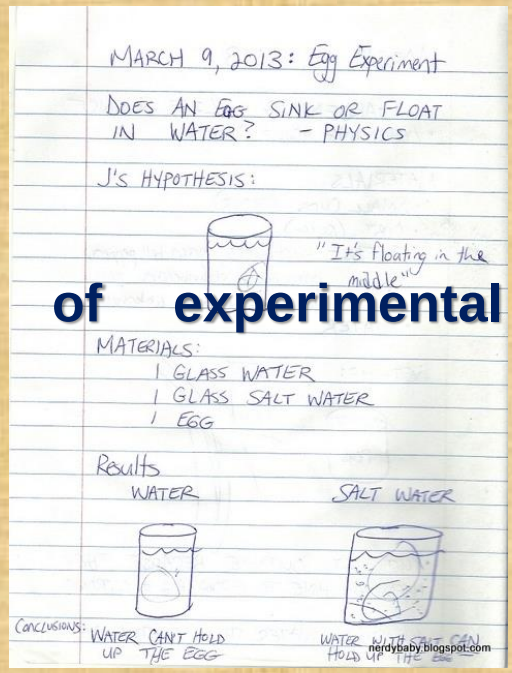
Laboratory notebook:

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. Abstract

- *Celia's foolproof abstract recipe:*

Answer the following questions, in this order, in one or two sentences each:

- **What problem did you study and why is it important?**
- **What methods did you use?**
- **What were your principal results?**
- **What did you learn? What have you contributed?**

courtesy of Celia Elliot

Course Objective. *Lab report*

The components of the report. Introduction

3. Introduction (Theory, motivation)

Introduction

Electromagnetism comprises one of the four fundamental forces of nature, and although the applications of electricity are more apparent in the layman's everyday life, the effects of magnetic fields, although more subtle, are no less profound nor less important. Pioneering 19th Century work conducted by experimentalists such as Michael Faraday and theoreticians including James Clerk Maxwell underpin the classical electromagnetic theory still widely used in several applications today, ranging from the spinning turbines in every electrical power station to the MRI scanners in all major hospitals. As such they remain an integral cornerstone of modern physical theory, hence the motivation for conducting this experiment.

Course Objective. *Lab report*

The components of the report. Introduction

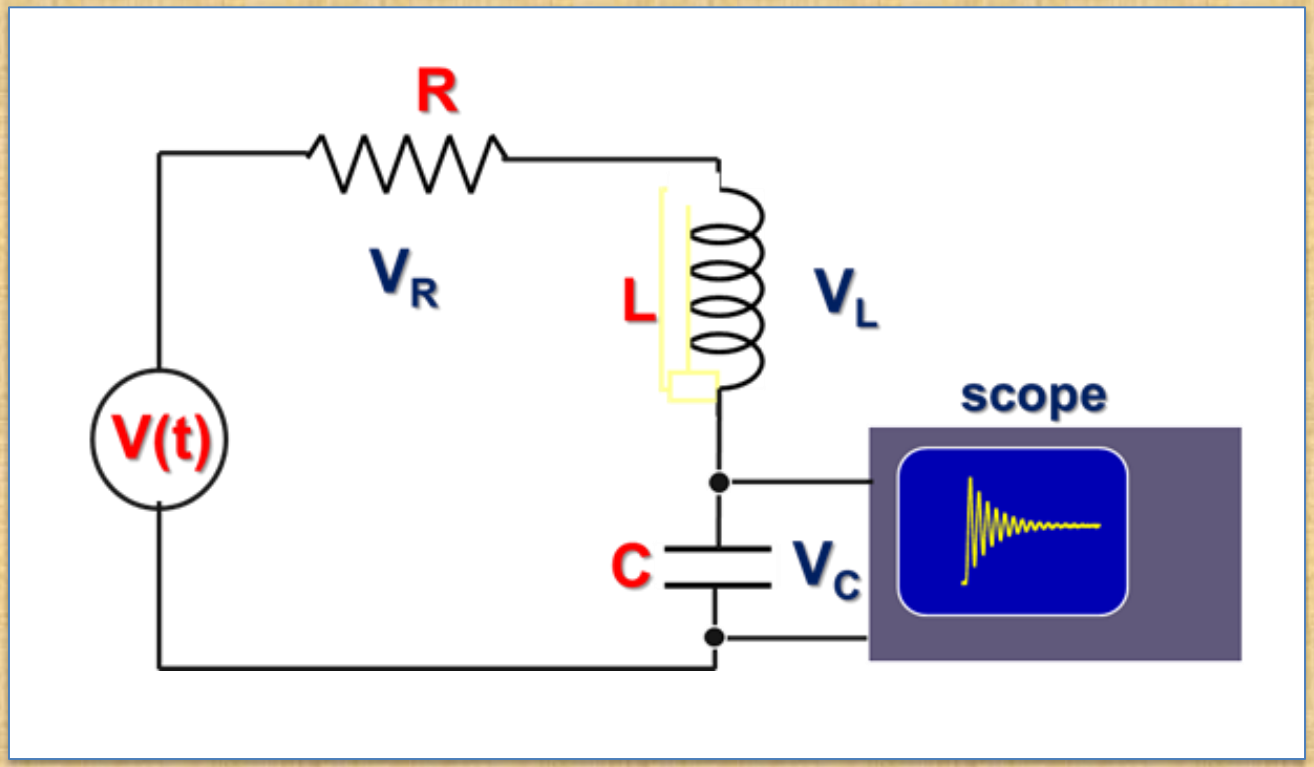
3. Introduction (Theory, motivation)

- **What Physics did you touch**
- **Historical excurse. Short and only if it is necessary**
- **From physics to measurable parameters.**

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. Procedure

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

- **Measuring idea**
- **Experimental setup. Show the diagram of the setup**
- **Used equipment**
- **Used DAQ software**

Course Objective. *Lab report*

The components of the report. Results

5. Results (main finding, analysis, errors)

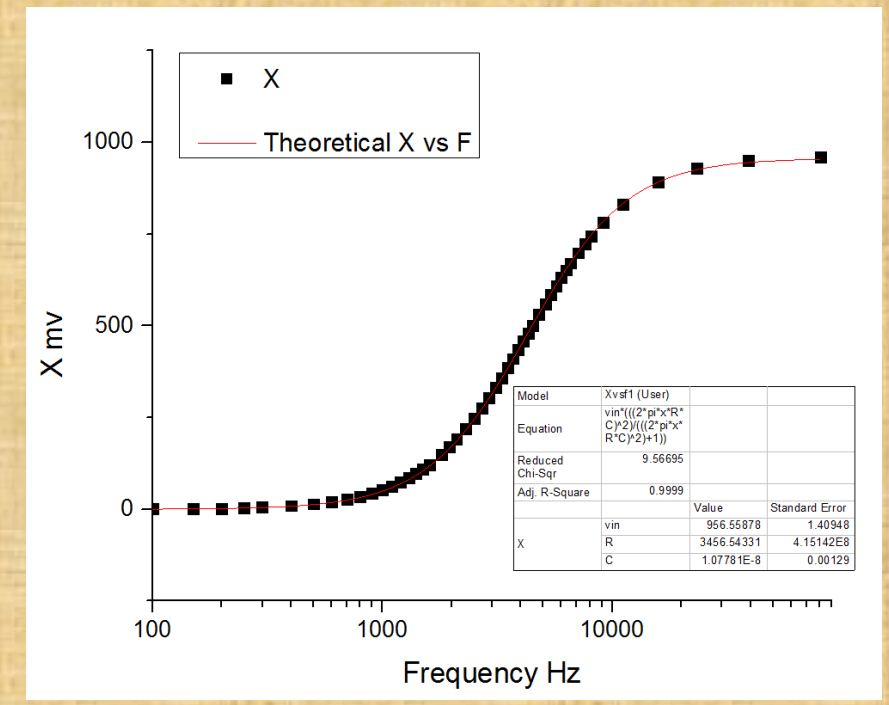


Figure 4. Graph of X vs Frequency over a wide range of frequencies in circuit A

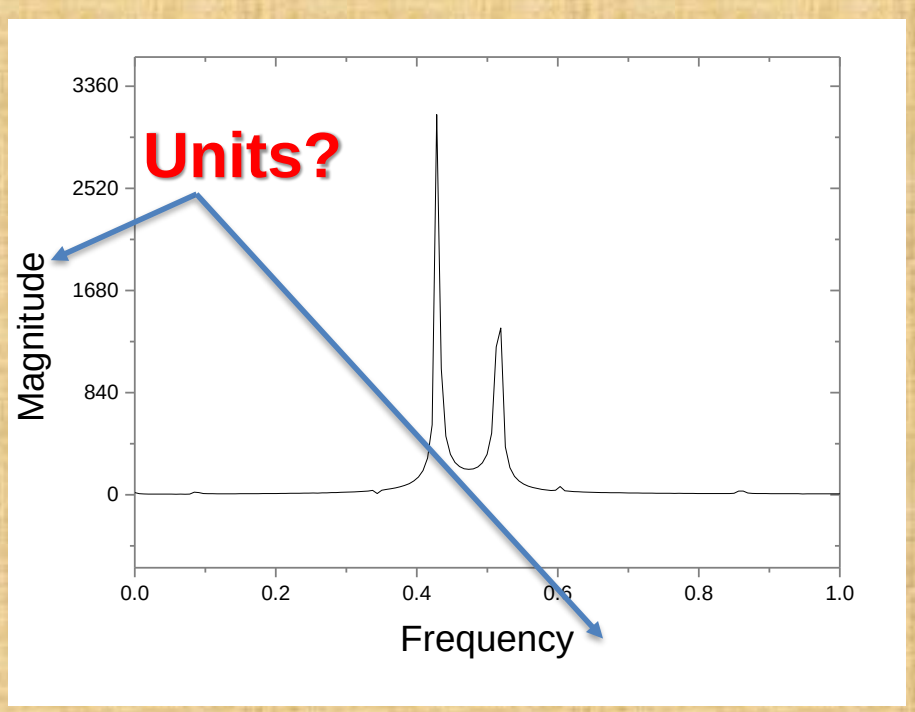


Figure caption ?

Course Objective. *Lab report*

The components of the report. Results

- **Show some raw results if it is appropriate**
- **From raw data obtained in experiment to physical parameters**
- **Errors, uncertainties, problems**

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*

The components of the report. Conclusions

- **Main findings obtained in experiment and after the data analysis**
- **Compare the obtained results with published/known ones.**

Course Objective. *Lab report*

Main suggestions haw to prepare a good report:

- **Proofreading and check spelling.**
- **Prepare the well "polished" graphs**
- **All graphs pictures and tables should be supplied by captions.**
- **Equations should be numbered**
- **All found physical parameters/results should be given with estimated errors.**
- **Take care about reasonable number of significant digits in all numerical results.**

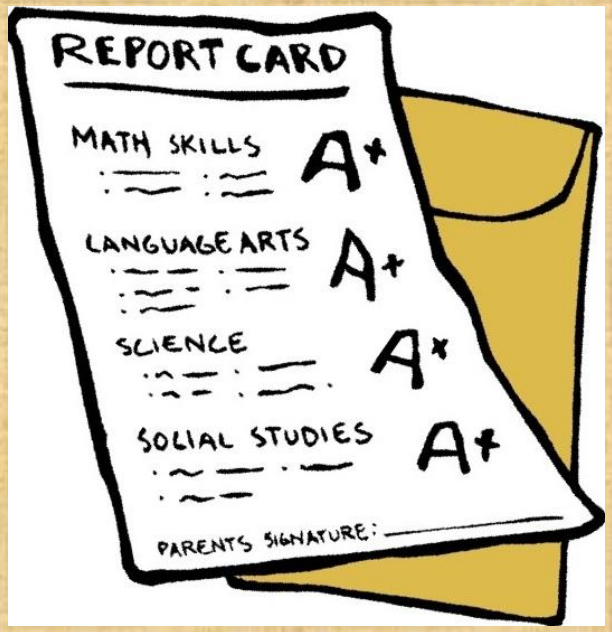
Course Objective. *Lab report*

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

An example of P401 good written report

An example of P403 good report

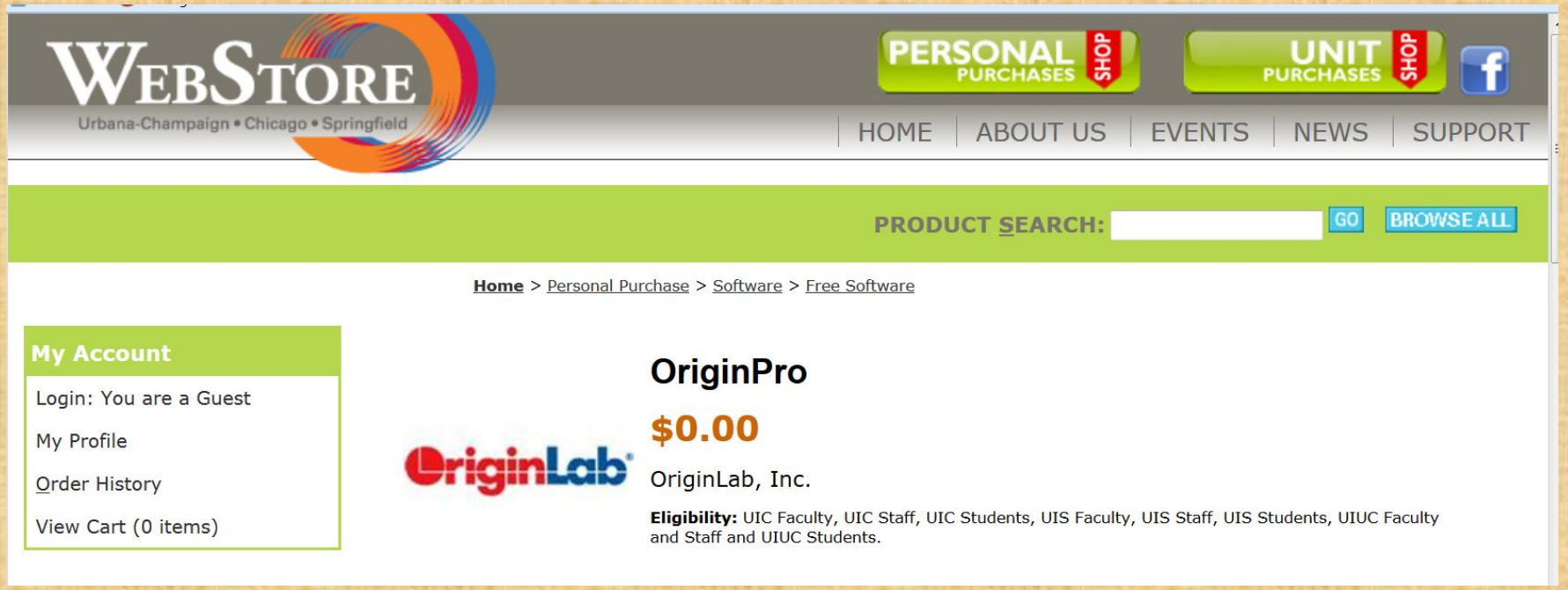
Writing Guidelines & Hints



Course Objective. *Lab report*

Graphs, graphical software

Origin can be used for data analysis and data presentation. There is 2018 version available on all Lab computers



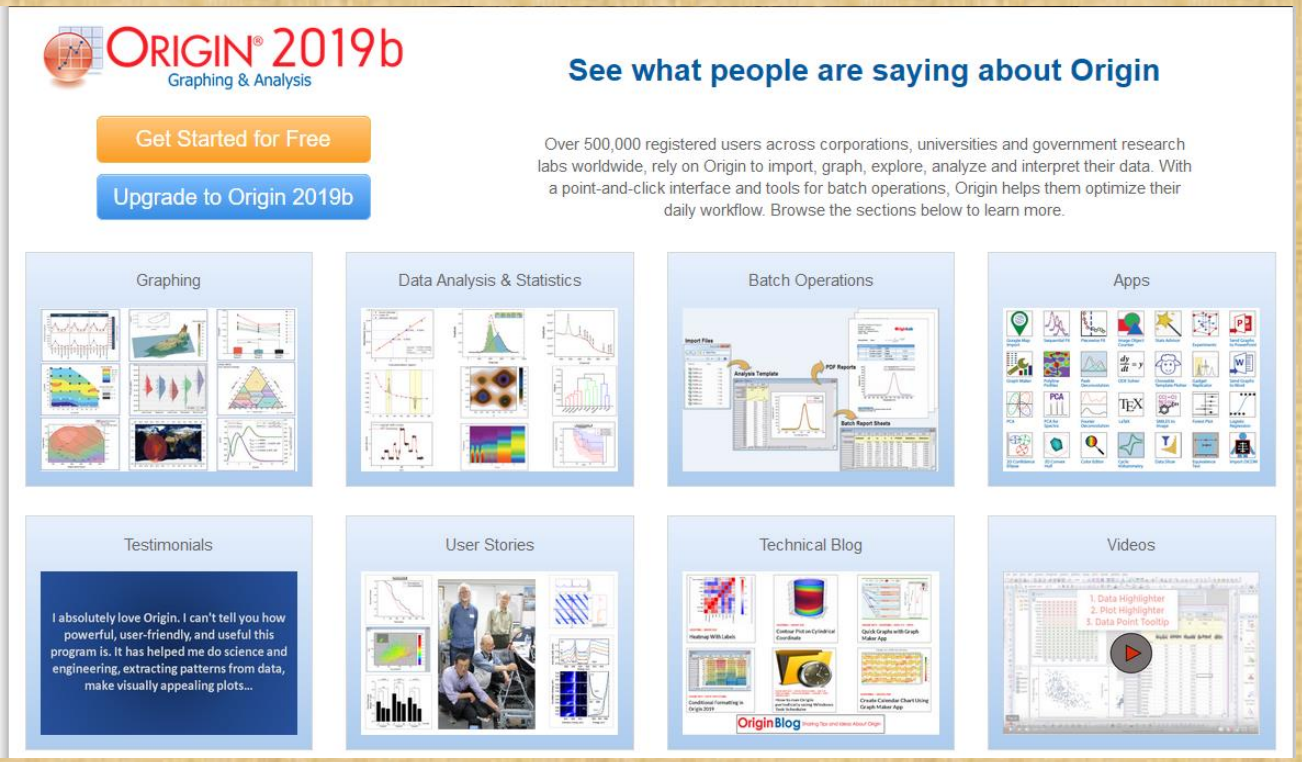
https://webstore.illinois.edu/Shop/product.aspx?zpid=1311

WebStore offers two versions: 2018 and 2019

Course Objective. *Lab report*

Graphs, graphical software

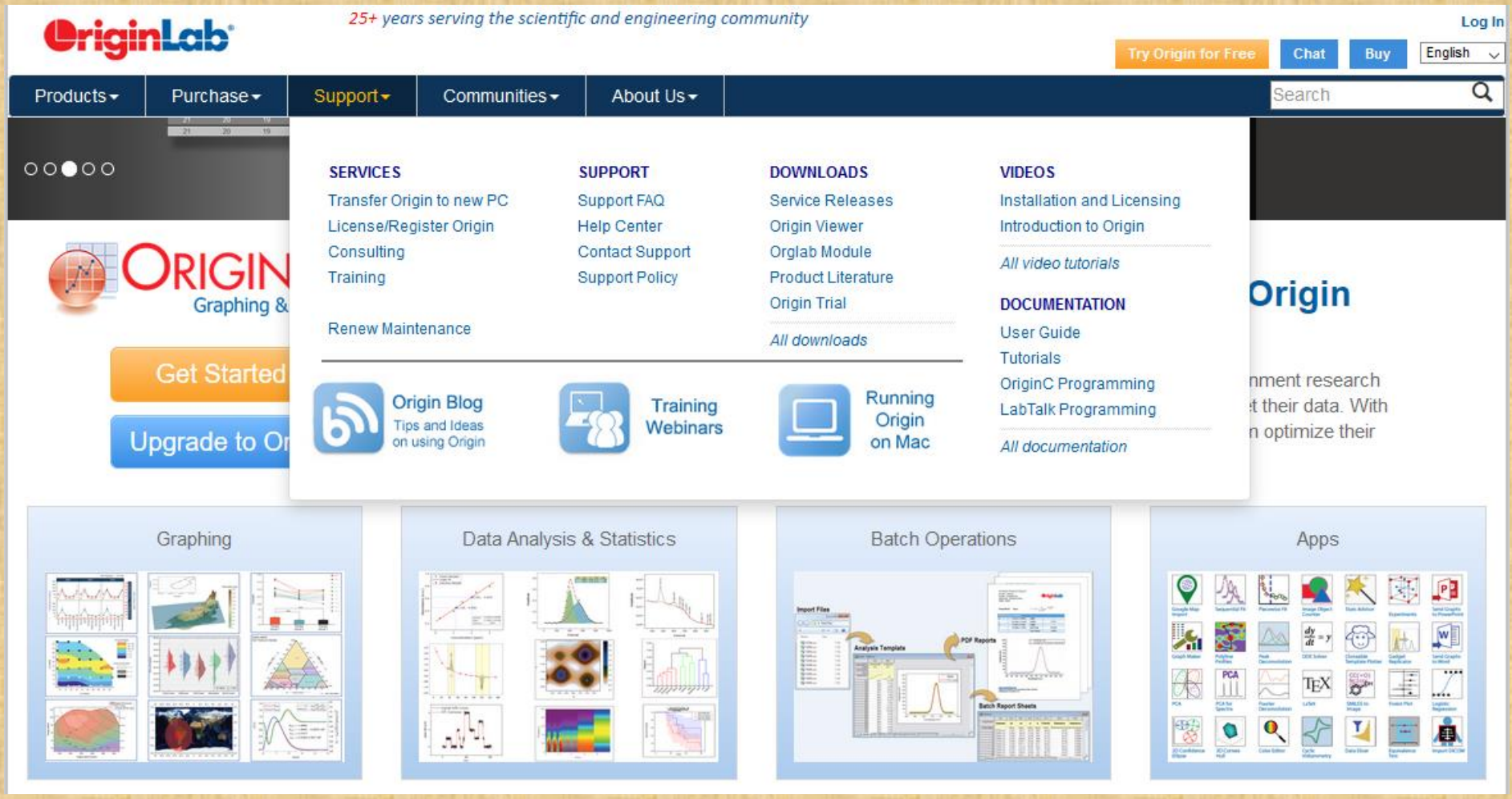
OriginLab has put together a handy multi-page booklet highlighting key features of Origin and OriginPro. An online version of this booklet is available here:



https://d2mvzyuse3lwjc.cloudfront.net/pdfs/Origin2019_Documentation/English/Booklet2019_E.pdf

Course Objective. *Lab report*

Graphs, graphical software

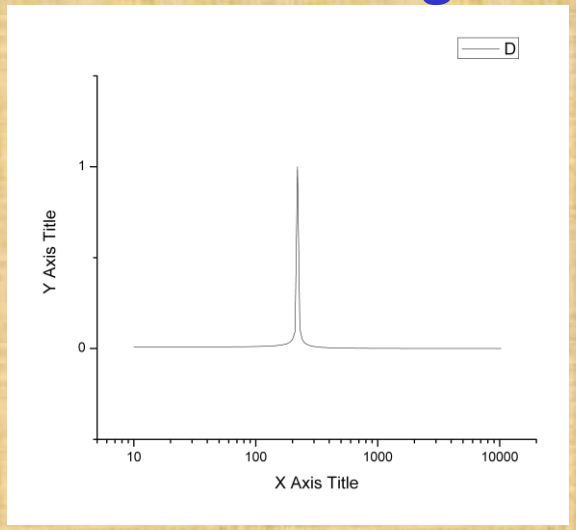


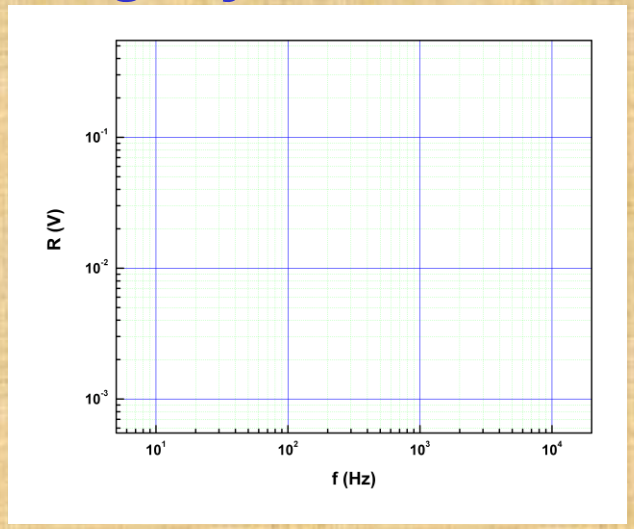
http://www.originlab.com/

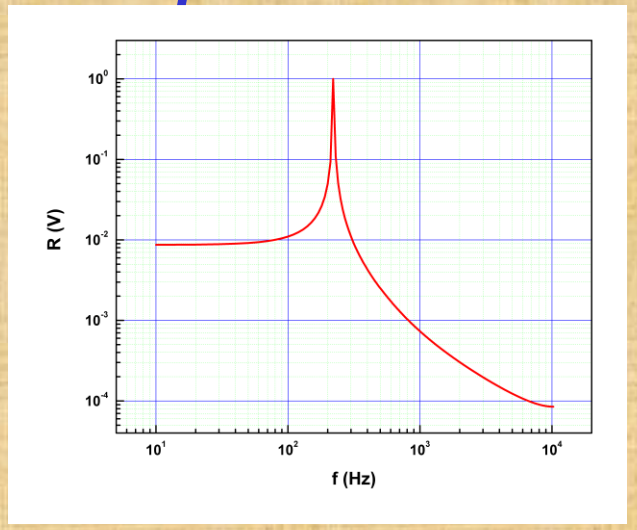
Course Objective. *Lab report*

Graphs, graphical software

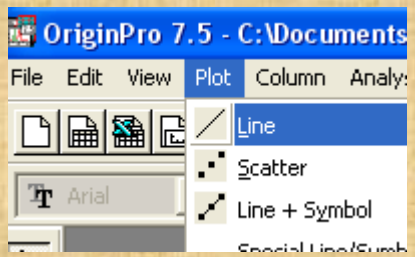
Working with Origin you can use the templates



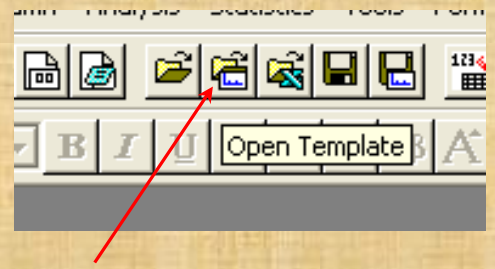




Simply plotting the data



Open the template

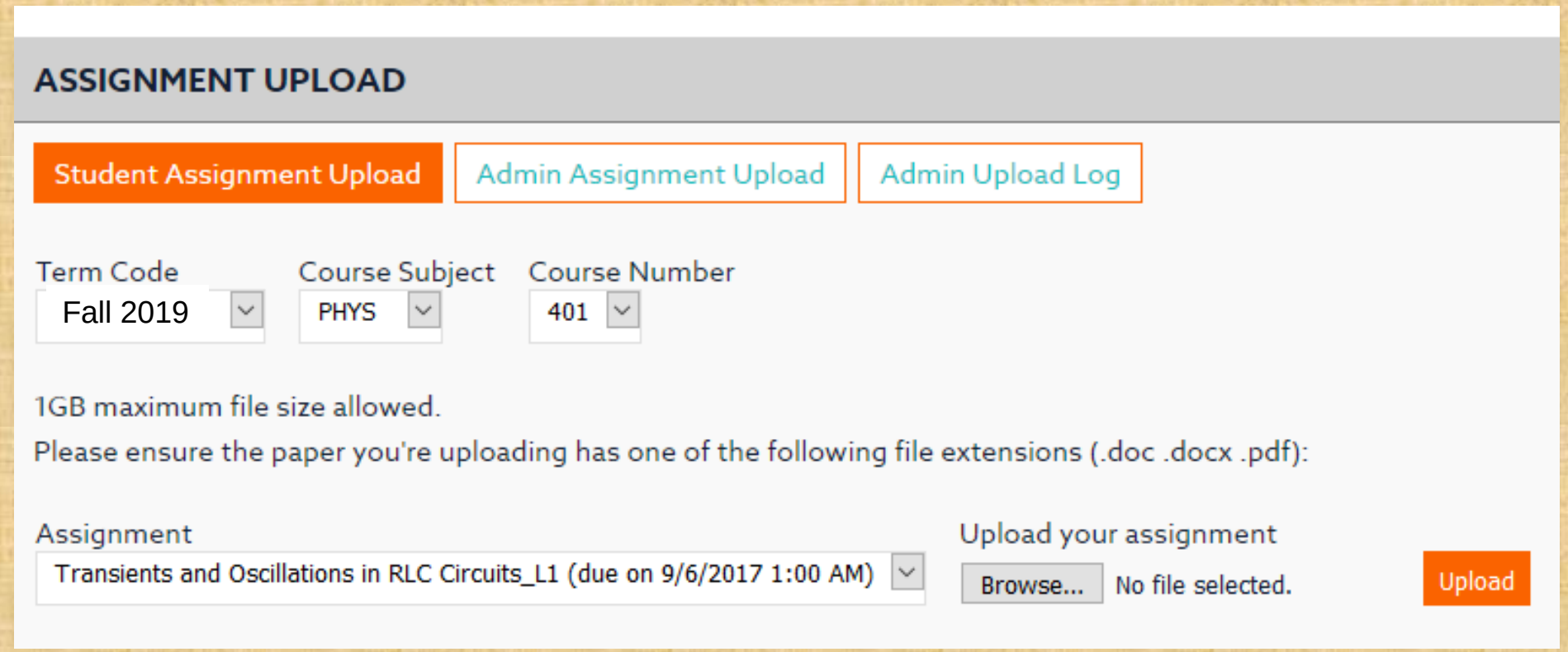


\\engr-file-03\phyinst\APL Courses\PHYCS401\Common\Origin templates

Course Objective.
Lab report. Submission

The reports should be uploaded to the server:

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



Course Objective.
Lab report. Submission

The reports should be uploaded to the server:

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

In a case if you have problems with electronic submission you can send the report file by e-mail as an attachment to your section TA and Eugene Colla (kolla@lllinois.edu), but this is exceptional case but not a regular rule!

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. Each *unused voucher* will give you *5 points* to your final score.

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

Date:
Experiment No.:
Student Name:
Signature:

void after May 9 2018

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

Date:
Experiment No.:
Student Name:
Signature:

void after May 9 2018

Course Objective. *Lab report*

Vouchers. The main rules:

- **Vouchers can not be used both together for the same report.**
- **Voucher can not be used after more week from the day of regular submission**
- **You have to inform your TA if you are going to use the voucher and preferably beforehand.**
- **Voucher can not be used for the final report.**
- **Credit for unused voucher/s will be added to the final report score or to any other one.**

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. *Lab report. Resubmission .*

You have a right to resubmit during the semester one report. The rules for resubmission are:

1. ***Original report should be submitted in time or with using a voucher***
2. ***Original report should be a real report but not a title page with author name***
3. ***The final report is not a subject for resubmission***
4. ***The deadline for resubmission is the same as for final report – December 15th 2019***

Course Objective.
Late reports

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 15th 2019 is the final deadline for everything**

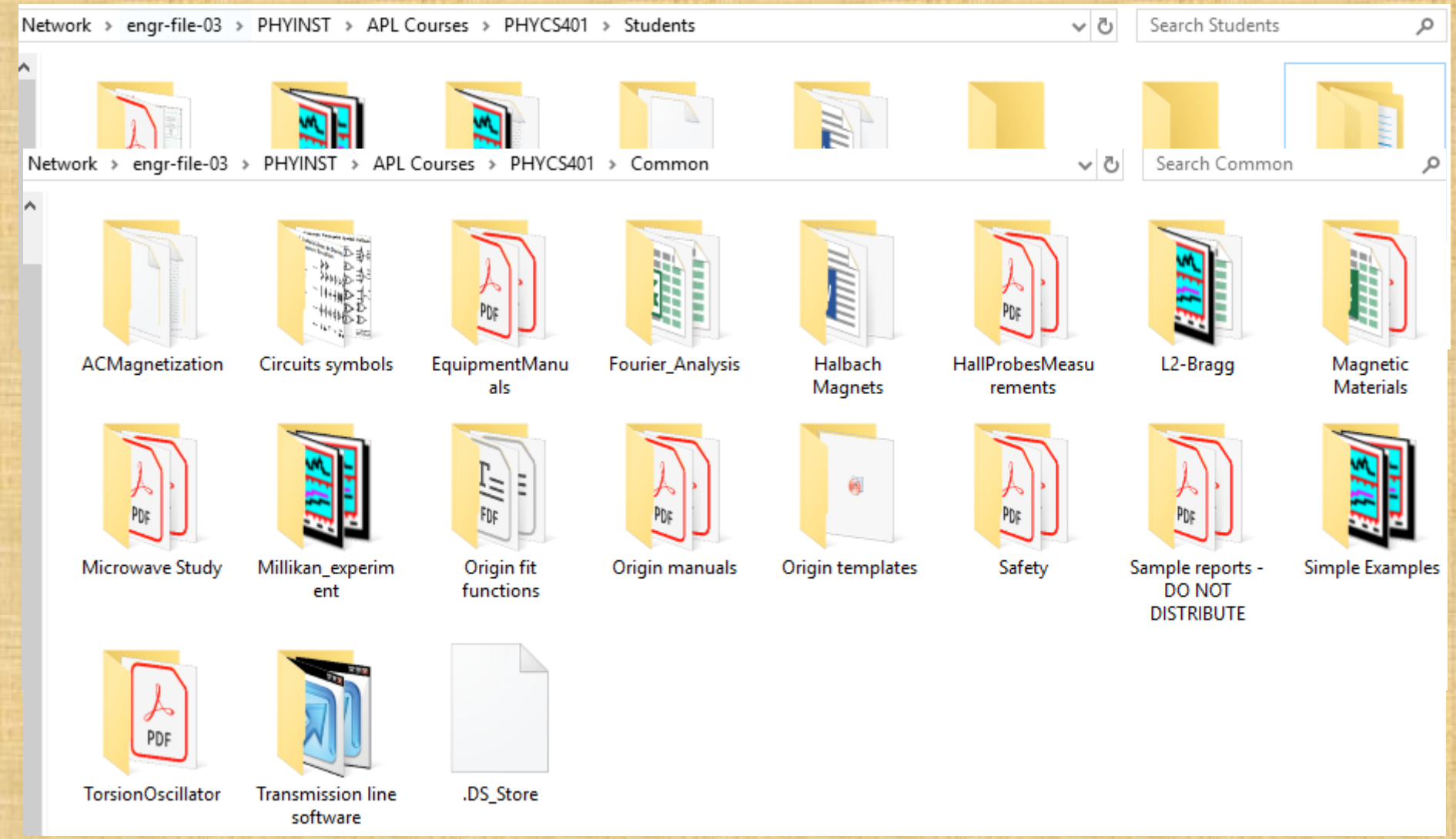
Course Objective.

Absences/Excuse policy

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

- ***You can be excused from only one missed assignment, and only if you provide medical or equivalent documentation.***
- ***The Final Experiment cannot be excused, as it is equivalent to a final exam. You cannot pass the course without credit for this assignment (see Student Code)***

Computer Access in P401



Safety is your responsibility !

Hazards: ***high voltage, chemical materials, hot equipment***

In class work requires

responsible conduct with regards to

(I) safety/hazards and with

(II) equipment

Discuss potential hazards at the beginning of each experiment with an instructor or TA

When in doubt stop and ask

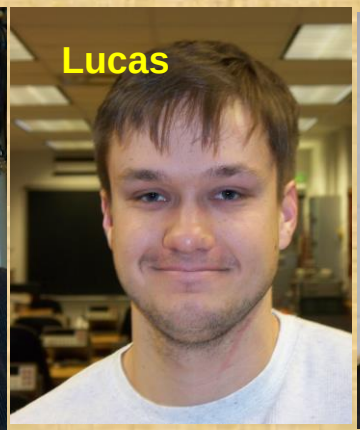
Typical Lab Routine

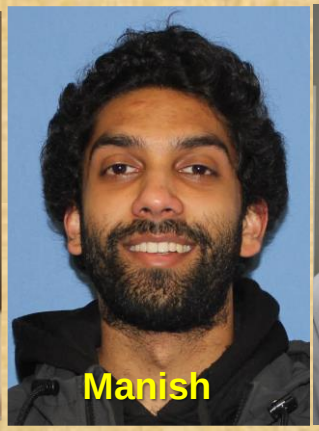
1. Reading the write-up (*better before the Lab session*)
2. Assembling the experimental setup. Drawing the diagram if it is necessary.
3. Taking data. Saving data using DAQ or writing manually the numbers in the notebook. In the case if data was obtained automatically you have to write in logbook the 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	Instructor
A	LEC	15:30 – 16:20	M	LLP 276	Eugene V Colla
L1	LAB	13:00 – 16:50	T	ESB 6103	Lucas Slattery
L2	LAB	13:00 – 16:50	W	ESB 6103	Jordan J Sickle
L3	LAB	08:00 – 11:50	R	ESB 6103	Albert Chun-Yuan Lam
L4	LAB	13:00 – 16:50	R	ESB 6103	Manish Shankla

Physics 401 staff





	Name	Office Hours	Phone	e-mail
Lecturer	Prof. Eugene V Colla	Monday 4:30-5:30 pm ESB 4137	333-5772	kolla@illinois.edu
Laboratory Instructor	Lucas Slattery	Tuesday 12:00-1:00pm ESB 6103		lslatte2@illinois.edu
Laboratory Instructor	Jordan J Sickle	Wednesday 5:00-6:00pm ESB 6103		sickle2@illinois.edu
Laboratory Instructor	Albert Lam	Thursday 12:00-1:00pm ESB 6103		aclam2@illinois.edu
Laboratory Instructor	Manish Shankla	Thursday 5:00-6:00pm ESB 6103		shankla2@illinois.edu
Laboratory Technician	Jack Boparai ESB 6101	None	333-2208	jboparai@illinois.edu

Semester Schedule

Week of	No. Weeks	Lab Title
August 26	1	Introduction to oscilloscope, function generator, digital multi-meter (DMM), and curve fitting.
September 2	1	Transients in RLC circuits
September 9	1	Frequency domain analysis of linear circuits using synchronous detection
September 16	1	Pulses in transmission lines
September 23	1 of 2	Millikan Oil Drop Experiment / Week 1
September 30	2 of 2	Millikan Oil Drop Experiment / Week 2
October 7	1 of 2	Torsion Oscillator / Week 1
October 14	2 of 2	Torsion Oscillator / Week 2
October 21	1	Hall Probe Measurement of Magnetic Fields
October28	1 of 2	Qualitative Studies with Microwaves / Week 1
November 4	2 of 2	Microwave Cavities / Week 2
November 12	1 of 3	Final Project - AC Measurement of Magnetic Susceptibility / Week 1
November 18	2 of 3	Final Project - AC Measurement of Magnetic Susceptibility / Week 2
November 25		Thanksgiving break
December 2	3 of 3	Final Project - AC Measurement of Magnetic Susceptibility / Week 3.
December 15		Final week: Final Project Reports due on December 15th at 11:59 PM. Reports should be submitted by uploading.

Grading

Total Points(max) =

1000(reports) +

60(Lectures attendance)

Total number of scaling points is 1060!

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-