

# Should Engineering Freshmen have an Engineering Laboratory in the First Semester?

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**Abstract** – When Engineering students enter the University, they usually have an idea about their chosen field of study and often are anxious to obtain some practical experience in their field. Courses in Physics and Chemistry will in most cases have laboratory sections but lack relevance when seen through the eyes of typical freshmen. Therefore a resounding yes should be given to the establishment of First Semester Engineering Labs, that will introduce all Engineering students to at least one or two lab sessions in what they perceive to be their chosen field or it could be the deciding factor to switch to a new major area of Engineering. Why should Electrical Engineering students wait one or two years before they can use a DMM or an Oscilloscope? Why should a Mechanical Engineering student not know now what a stress test does to a aluminum or steel sample or why shouldn't a Civil Engineering student enjoy surveying part of the campus? It is in Laboratory settings like this that faculty members get to know their students much better than in lecture settings and the one on one creates an atmosphere that can do wonders for retention. If they have the initial qualifications for Engineering studies, most students drop out or switch majors because excitement and focus is missing in their chosen Engineering field and this is where a well designed first semester laboratory course can be very helpful in reducing the perceived drudgery and lack of focus.

*INDEX TERMS* – Freshmen Laboratory, Relevance and Focus, Excitement, Retention.

## Introduction

True Engineering has always been based on proving theoretical concepts in the laboratory and whether we go back as far as Thomas Edison or as recent as Shockley developing the transistor or Maurer, Keck and Schultz at Corning developing the foundations for fiber optics, the lab will be the final proving ground for all Engineering developments.

There seems to be a reluctance of Engineering departments across the country and around the world, to incorporate laboratory exposure and experience into their curriculum. Is it a belief that we are too scholarly to bother with such mundane experiences or is it dictated by the practical knowledge of laboratory courses providing no FET's but a great amount of development time. We can learn something from the

Engineering Technology curriculums, where nearly every course has an accompanying lab. We don't have to go as far or the same route but in certain cases laboratory experiences will add a great amount of substance and value to Engineering curriculums.

This is where a Freshmen Engineering laboratory comes into the picture. Incoming students are usually bewildered and lost in the first few weeks of a semester and the pace and demands of Engineering coursework overwhelms many of them. However the lab sessions of the first week and subsequent weeks gives them right away an experience that can be very positive. Here they have a partner that will work with them to solve a problem and that professor who seemed so distant and unapproachable in the theory portion of the course is working with the students on a one to one basis. Attention span in a lecture is 20 minutes, here in the lab it is an hour and a half. Some of the students make arrangements to get together later on to write up the required report and to finalize some of the lab results.

## Laboratory Outline

At the University of Pittsburgh at Bradford the Freshmen lab is part of Engr-0011 which is titled Introduction to Engineering Analysis. Topics of the lab can be taken from the theory but it is not absolutely necessary to follow that regimen. Lab#1 outlines the requirements that are necessary for performing an Engineering Lab. How to take data, what kind of notebook to use, how to draw a graph manually or using computer assistance. Here we lay the foundation for proper recording of results and prepare for future Engineering work. One should realize that this happens during the first week of the semester, which shows the emphasis placed on lab Performance. Lab#2 and Lab#3 are introductions to basic electrical measurements. Finding out how to use a DMM a VOM and an Oscilloscope is not just the what an Electrical Engineering student should know but is very useful and interesting to all Engineering Freshmen. Not all of the labs are performed with instrumentation or are situated in the basic Engineering Lab facility. Virtual labs provided by Agilent Technologies[1] can be performed at any computer station and give students insight into techniques that are extremely useful. Most of the students however prefer the real hands on procedures even though these labs are not as forgiving as virtual labs. Field trips to local companies count as labs and require a lab write up and research about the company and its

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products. Usually two field trips per semester give students a real world look at Engineering and Productivity of a company and therefore including them as labs makes perfect sense. Some lab exercises require more than one lab session . An example of this is a surveying lab where one session deals with the theory of surveying and familiarization with the equipment while the other session is a surveying exercise of parts of the campus. A very popular lab exercise is a Mechanical Engineering Stress and Strain session[4]. Paralleling the theory in Engr-.0011 samples of aluminum and steel are stressed to the point of failure and analysis of the results is portrayed with graphing in Excel.[2]

### Examples of Lab Setups and Student Work

In the following section numerous illustrations of student work and lab set ups show how a first semester laboratory course gives students a valuable experience and contributes to understanding various facets of Engineering.

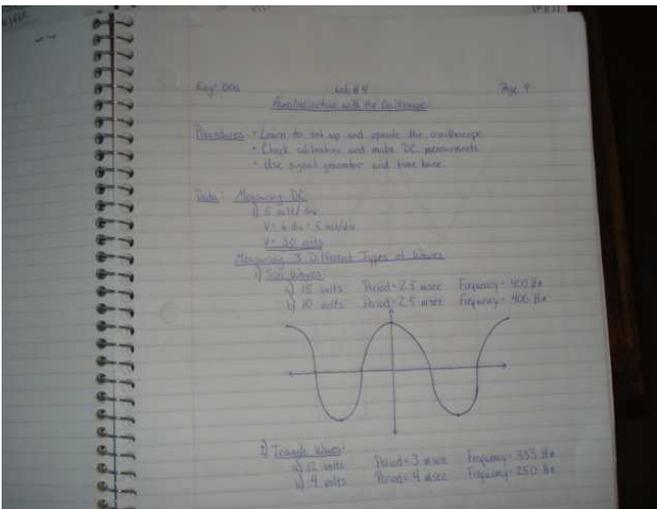


FIGURE III The write up on the Oscilloscope[6]



FIGURE I Matt and Justin are setting up to test a simple circuit

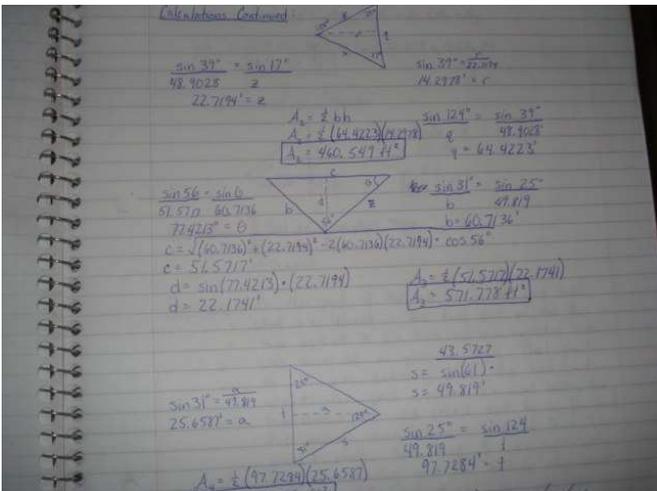


FIGURE IV How the law of sines helps in determining the total area of the survey through triangulation[6]



FIGURE II Josh, Jacob and Andy are using the Oscilloscope



FIGURE V Josh examines the test sample after failure

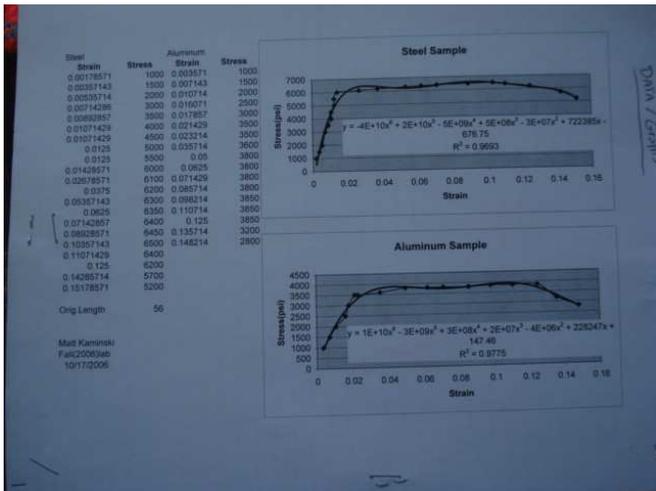


FIGURE VI Write up on stress and strain lab[4],[7]

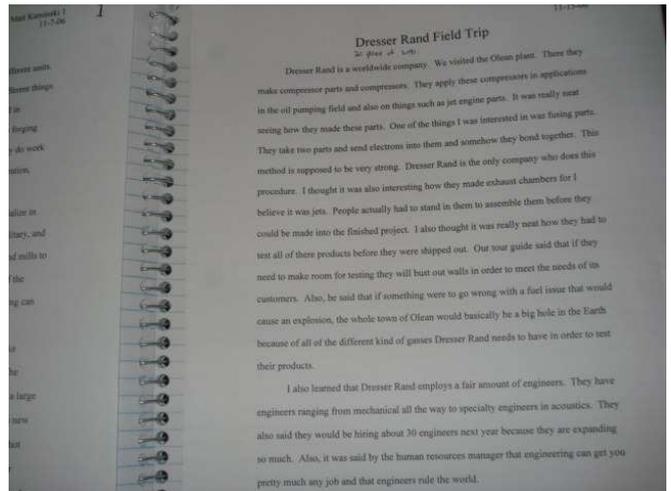


FIGURE VIII Write up on the Dresser-Rand field trip[7]

As was mentioned previously, field trips are part of the laboratory sequence so therefore attendance is mandatory. This however is not a problem because on student evaluations of the course, field trips rank very high. Since we are located in an area that does not have an abundance of industries it sometimes is difficult to balance the industry visitations so all areas of Engineering are accommodated.

The picture below shows students at Olean Advanced Products, a manufacturer of capacitors for military and other highly specialized applications. The company is a part of AVX[3] corporation. To balance the electrical type of company a mechanical manufacturer was visited next and the write up on the Dresser Rand company shows that it is a worldwide leader in the manufacture of compressors so mechanical Engineering students were given the privilege of this visit. In the past chemical companies, refineries and dam construction sites have been field trip locations.

Two, sometimes three lab periods are reserved for students finalizing their required Freshmen project. Teams of three or four students are presenting these projects to the campus community at the end of the fall semester. Quite often the team members of the Project will be partners in the lab exercises also.



FIGURE VII Students at Olean Advanced Products in Olean New York[5]



FIGURE IX Showing off their Hover Craft Project[5]



FIGURE X Lindsay and Tim showing their convertible dorm cabinet[5]

## Conclusions

Hopefully it has been demonstrated that a Freshmen Engineering Laboratory has many merits. Students from day one feel that they belong. This is a setting that promotes comradeship and promotes student to professor linkage. Since the laboratory is interdisciplinary nobody feels left out. It does not require a huge outlay of capital and does not require fancy facilities. Many times students will comment in later semesters that they remember having done this or that in Freshmen Laboratory. Using the lab to acquaint students with industry, the places where they will go after graduation has many benefits. They can actually perceive what it will be like to go to work in such places and can say to them selves yes I really like this or they might find what they wanted to do needs reevaluation.

On the part of the instructor it means a lot of commitment and practical experience. Students have to be mentored and advised in principles of Electrical, Mechanical and Civil Engineering and equipment has to be kept up and every so often be replaced. Lab notebooks have to be evaluated and extra Lab sessions might have to be scheduled.

A side benefit is the feeling of students that this Lab is their home away from home and they sometimes spend all their study times with their friends and partners in the Lab. It helps of course to have networked computer stations and a printer available for them.

## Acknowledgement

First of all I would like to thank my wife Celeste for encouragement and for looking over the paper for any glaring errors and spelling mistakes. For over 40 years she has stood by and supported this Engineer in all of his endeavors. Thank you very much!

Secondly, thanks go to the Faculty Development Committee and Dean Hardin for providing funding for attending the conference.

Finally, I would like to thank all the students who have worked hard during their first semester and provided some of the background and their pictures for this paper.

## References

- [1] Agilent is the Logo of Agilent Technologies a HP company
- [2] Excel is a copyright of Microsoft corporation
- [3] AVX is the logo of the AVX corporation
- [4] Klaus Wuersig, Intertech 2002, VII International Conference on Engineering and Technology Education Santos Brazil 2002
- [5] Klaus Wuersig, Internal Documents
- [6] Notebook of Josh Parslow
- [7] Notebook of Matt Kaminsky