1.0 Introduction

This document is a brief overview of some of the important issues regarding the planning and design of experiments – especially under severe time and cost constraints. *It is by no means exhaustive!* A quick web search will reveal numerous resources on experimental planning and design. Experimental design in itself is a very broad field of study whose principal focus is the design of experiments in order to minimize the number of samples and the number of different experiments to run in order to obtain results statistically significant enough to draw conclusions from.

The focus of this brief is much more basic. Specifically, this document deals with the feasibility of a given experimental idea under severe time and cost constraints. Once an experimental idea passes the feasibility test, the next step, the experimental design, is the topic covered in the bulk of the literature on the subject. In ME242, we will not delve into this topic to any significant extent, but will refer those interested to the literature on the subject.

2.0 Feasibility of an Experiment

In ME242, we are concerned with systems encountered in mechanical engineering. This is a very broad topical area! Practically any physical system falls into this area. Here are some of the questions that must be answered before conducting an experiment:

1. How do you choose which system to study?
2. What constitutes a reasonable experimental question?
3. What is measurable in a given system?
4. What must be derived from more fundamental measurements?
5. How long will it take to assemble the materials required to conduct the experiment?
6. How much will it cost?
7. How long will it take to conduct the experiment?

2.1 How to choose an experiment to conduct

In practice, the choice of what experiment to run is driven by application. In industry, we might be faced with the need to determine the reliability of a certain component or system of components. In ME242, the choice is driven by three things: (1) your interest, (2) feasibility and compatibility with ME242 Requirements for the 4th experiment:

1. Must contain an experimental component – i.e. measurement of a system property or properties
2. Must be based on sound physical principles
3. Must test a hypothesis or mathematical model – best if all experimental hypotheses can be reduced to mathematical models.

2.2 Reasonable experimental goals – feasibility

The following conditions must obtain before starting an experiment:

1. A defined and understood physical basis for the experiment exists, and you understand it. If there is no physical basis for a physical experiment, how could expect to obtain meaningful results?!

2. You have examined the relevant literature on the subject to see what has been done before. This is a critical step. In ME242, it is not necessary to perform an original study, but it is necessary to cite prior work – especially if you are essentially trying to duplicate that work. Clearly, the more your study deviates from prior studies, the more likely it is publishable.

3. You must be able to conduct the work within the time and budget allotted. In ME242, we have a semester limit of $100.00 except when the product may be used in our curriculum. If we can use the results of your experiment as a teaching tool in ME242 or any other class, we are generally willing to spend more.

4. The physical quantities that you want to measure must actually be measurable with the equipment that is available to you. Quantities such as maximum frequency, minimum voltage, maximum temperature, flow-rate, etc., are examples of physical parameters that you must identify in order to determine feasibility.

5. You must understand exactly what you will measure as apposed to what you will derive from what you measure. This means that you should have the relevant theory worked out, and be prepared to test it with your measured data on the fly while conducting the experiment if at all possible to determine if your results are as expected. This is necessary to catch any potential measurement problems before you’ve taken tons of data!

After you have identified and clearly defined reasonable experimental goals through the application of the five conditions above, you must do a critical path analysis to determine what needs to happen in what order for you to succeed. Usually, the critical path to a project goal goes through certain sequential milestones that must occur before the next step can be taken. Some of the key issues are:

1. Availability of equipment, facilities, and other resources.

2. Availability of team members. How much time can each member of your group spend on this project? Who will do what? When will they do it?
3. Supply/vendor time lag. This is a critical issue that bites most engineers at some point in their careers! How long will the vendor take to send you what you need? Should you order it from more than one source to make sure you get it in time? What are the return/cancellation policies of the vendor?

**In short, you should create a project plan for your experiment.**