Graduate Student Guidelines
University Science Malaysia
Prof. Horizon Gitano, April-2010

INTRODUCTION

This is a brief set of guide lines for my graduate students. The intent is to set up a general “frame work” or structure which the individual students will use in organizing their graduate work, writing it up and publishing the results.

Essentially a graduate student is required to perform detailed scientifically valid analysis, create appropriate designs, fabricate and test their design to verify its performance which is then compared to theory, the results of others and the initial design goals. This involves both basic parametric modeling and detailed Finite Element Modeling (FEM or CFD) as well as analytical work. The bulk of the work should be experimental in nature: a simulation is just a tool to aid in the design of a real system and not an end in itself. There is an excellent expression I fully support: *“If you do experimental work you are the only one who doubts your numbers. If you do simulation work you are the only one who believes your numbers*”. A good experimentalist can always see the errors in his setup and knows the limitations of his data, ie. the % error. It is all too easy to throw together a simulation which will give you results, even if the input parameters are not correct, or the meshing is wrong, or the analysis is inappropriate, and you’ll still get numbers out (garbage in, garbage out). Unless you have very good correlation data (this means correlation to experimental work) then no one will believe your numbers.

GENERAL REQUIREMENTS: Masters

For a masters student the general rule is that, through your work you can prove that you can make scientifically valid **models**, **measurements** and **analysis**. The model should effectively predict the systems behavior, and ideally it is used to design or optimize a complex system, which is then fabricated, and tested. The data from testing need to be analyzed in order to understand the behavior of the system, and related back to the model. The model should be based on fundamental physical laws, such as the conservation of energy and etc.

For my students you are expected to perform world-class work, and prove it by publishing that work in international journals. The "rule of thumb" is that you should produce ***one international journal paper per year***. For example in the first year you may collect a lot of data on your subject, develop a model, and use the model to design or optimize your system, with predicted results. Provided it is done correctly with enough attention to the appropriate parameters, this is a perfect 1st publication. After this you may fabricate or modify your system, and then test it. Test results will require analysis in order to understand exactly what is happening in your system. You should collect sufficient data to tell if your system is behaving as you expected, and if not why not. The "performance" of your system makes an excellent 2nd paper, and should reference your earlier work. Some times the system will then be placed in use, and the long-term "real-world" ramifications of your design/modifications can be obtained and assessed. This can easily be a 3rd paper.

Typical duration of a masters study (full time) is 2 to 3 years, so you should produce 2 to 3 journal papers.

GENERAL REQUIREMENTS: PhD

For a PhD the requirements are the same for masters, but your work is expected to "generate new knowledge" or expand the state of the art of engineering sciences in your field. You should be creating something new which has not been done before. You work should be flawless, as it will be referenced by others working in this area in the future. Basically you are writing the text book for this new area, or at least your part of it.

This obviously takes more time than a masters, typically 3 to 5 years, with a correspondingly higher number of publications of higher quality.

INDUSTRIAL RESEARCH

Mechanical Engineering is an applied science. As engineers we are not interested in "knowledge for knowledge's sake", we aspire to end results which can benefit mankind in a direct manner. The end goal of our work should be commercialization. **Industrial Research** projects are an important aspect of the lab and any good university relies heavily on

Industrial Research grants to supplant the government/academic grants, to train the graduate and under grad students on “real world” problems, and to supply in-depth R&D to industries which would otherwise have a hard time affording the tools and infrastructure available at the University. These projects generally have a relatively tight time line, and may include travel and off-site work at the industrial client’s facilities. All graduate students are required to participate in Industrial Research projects as time and schedule permits. This provides excellent training and experience to the student, and may open the door to future employment.

APPROXIMATE TIMELINE

The timeline presented here is for a Mastes student. For a PhD the schedule is basically the same but the extra time (ie. 1 or 2 years) is spent re-designing, fabricating and testing more sophisticated experiments, and taking a greater amount of data on your project, As you progress the quality of your work is expected to continually improve.

First Month

Meet with me and decide on a topic, read everything you can find on your area, look up everything in the appropriate field of study from journal articles to machine specifications, text books and popular literature.

By month 3

By now the literature review should be well underway. This will continue **the whole** duration of your studies. The work of a graduate student is never finished: you are reading, and designing and reading and building, and reading and taking data, and reading and analyzing… You should review on average one new journal article per week, so after 2 years you’ll have at least 100 relevant papers in your references. Generate a proposal for your plan of study including mile stones and a time line. I will review this with you, and once it is acceptable, it will go into your file, and later progress will be compared to this initial proposal. Also you will have to present your proposal to the group for review. ***You should start taking data immediately***. Do not wait to design the “perfect” experiment, because you are a fresh engineer which means whatever you design will probably not work like you want it to, so spending a lot of time “designing” without experience is basically wasting time. Collect data however you can. Take more and better data as you go. Use the data taken and techniques to guide you to better designs and better data. The more data the better.

There will be a review of your progress after about 3 months. If your work is not sufficient you will be warned or terminated.

By month 6

PhD students have to attend the “Research Methodology” course, and present their plan of study to their committee, this is strongly recommended for masters students as well. All students should target a journal for their first publication by this time. Take “base line data” on the existing system, if applicable. This data should be used in your model. Generate your model and verify it with your data or data from literature.

You will have a 2nd major review after 6 months. If your work is insufficient you will be terminated. This is not meant as a threat, nor to be arbitrarily cruel; it is to prevent a graduate student from “dragging out” a long and painful course of study for several years then failing to graduate. Although I wish it never happened *about 10% of my graduates are terminated without finishing their studies.*

By month 12
First publication: Modeling/Design of your system. This is a good time to present to the group again as your "mid-term progress presentation". Fabrication of your 1st round of experiments should be complete, and testing should be underway.

12-18 Months
Testing, modifications, retesting and analysis. You should be collecting lots of data by now. Plan your 2nd paper, get the data and write it up.

12-24 Months
Analyze all the data and compare it with the model, predictions and literature. Understand and be able to explain how and why your system behaves as it does. Publish this as your 2nd paper.

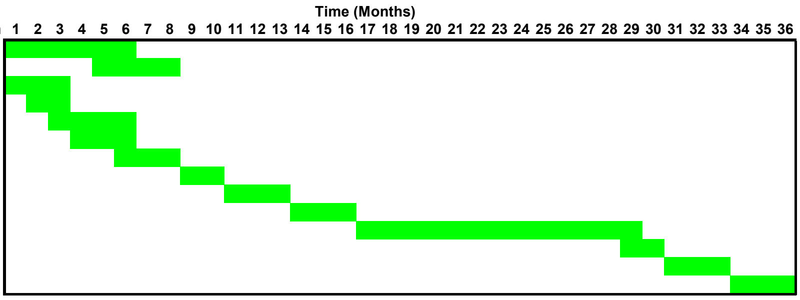
24-30 Months
Place your system in use or further optimize it, and collect long-term performance data. This may become a 3rd publication. Finish writing up your thesis, which is a compilation of your 1st, 2nd, and 3rd papers.

30 Months
Thesis defense and graduation!

This is what a timeline/Mile stones might look like in your proposal. Note that the schedule is tighter at the beginning: more time is spent gathering the data rather than just designing. This allows for more "mid-course corrections".

Work Chart **Sliding Friction Reduction Project**

Step		Duration
1	Develop Oscillating Wear Tester	6
2	Implement Stribeck Tester	4
3	Acquire Matrix Materials	3
4	Acquire Inclusion Materials	2
5	Measure Lube Affinity	4
6	Process Inclusions for size Dist.	3
7	Prepare Initial Samples	3
8	Measure surface properties	2
9	Run Initial tests	3
10	Refine tester/tests	3
11	Run multiple samples	12
12	Select best combination	2
13	Prepare actual bore for comparison	3
14	Compare bore-shaped sample	3



MileStones **Sliding Friction Reduction Project**

	Milestones	Month (per milestone)
1	Commission Wear Tester and Stribeck Tester	9
2	Run initial Samples	16
3	Select Best Sample combination for production of Bore-shaped sample	29
4	Compare Bore-shaped sample to existing materials/surfaces	36

GRADUATE STUDENT RESPONSIBILITIES

Literature Review

Generally I will supply new graduate students with a few "feeder" papers on the subject I assign them to. This does not constitute the literature review! The graduate student is responsible for performing a thural search of all the related material and keeping it up to date, right up to thesis submission. There is no "duration of literature review" because it begins as soon as the subject is decided on, and ends when he graduates.

Fabrication

It is expected that the graduate student has actually graduated from a mechanical engineering undergrad program somewhere, and that he has learned the basic skills required to fabricate fixtures and experimental setups. If there is a budget and if the fabrication of a part is especially complex we might send it out for fabrication, but in general the students are responsible for fabricating their experimental apparatus.

Paper Writing

The students are responsible for deciding where the most appropriate place to publish is. This should be based on the work performed and the literature review: Where are others publishing this work? Where will this work make the largest impact? That is where to publish. As most of my students are not English first language speakers, I have to do a lot of paper re-writing. This is not a problem provided the student has a well thought out plan for the paper, and has all the data required. Generally I find that the student has to go back and take more data to prove out what is being claimed in the paper. In the end there are usually several iterations per paper required to get it to a publishable state. Start early! It is not acceptable to hand your advisor an incomplete paper, poorly written and organized which has a dead line the following day. Start early and finish early.

Data Taking

The student is 100% responsible for the integrity of his data. He must know the calibration of every part of hit apparatus, and know the accuracy of his data. He is required to take sufficient data to prove out his hypothesis, and will likely have to take data and present it on various aspects of the experimental apparatus, materials used, and etc. In the end the student must PROVE his hypothesis, which means he has to verify every single step in the process.

Scheduling
The university has many ever changing rules and regulations regarding a graduate student's progress. It is the responsibility of the student to keep track of this and make sure he meets all the required check points.

LIST OF SUGGESTED READING MATERIALS

As a university student you are expected to get an education in more than just your specific field. There are a number of excellent books which are both informative and entertaining which I suggest all graduate students read. These books also help put what you are doing into perspective. I maintain a library of these books for my students to access:

"Small is Beautiful" by E. F. Schumacher
This is one of the earliest works illuminating why we need to develop sustainably.

"Design for the Real World" by Victor Papanek
Another early work relating to ethical application of engineering talent.

"Gossamer Odyssey" by Morton Grosser
Great documentary about the human powered flight across the English Channel.

"Ship of Gold in the Deep Blue Sea"
Documentary on the development of underwater robotic technology.

"The Search for Longitude"
Documentary of the development of accurate clocks for use in naval navigation.

"The World is Flat" by Thomas L. Friedman
This is about the globalization of markets and the economy.

"Hot, Flat and Crowded" by Thomas L. Friedman
This books looks more into the effect of globalization on the environment.

"Freakanomics"
Interesting perspective on economics and statistical analysis.

"Guns, Germs and Steel" by Jared Daimond
A well researched explanation of the spread of civilization and technology.

"Collapse" by Jared Daimond
A look at how and why civilizations expand and collapse related with environmental impacts.