



Center for Structures in eXtreme Environments (csXe) <http://csXe.rutgers.edu/>  
98 Brett Road, Piscataway, New Jersey 08854-8058

(732) 445-4408 FAX (732) 445-3124 e-mail: [benaroya@rci.rutgers.edu](mailto:benaroya@rci.rutgers.edu)  
<http://coewww.rutgers.edu/~benaroya/>

Haym Benaroya  
Professor of Mechanical and Aerospace Engineering  
Director of csXe

## **GRADUATE STUDY-- Towards a Thesis and Dissertation**

Advisor: Prof. H. Benaroya

This is a brief summary of my approach to advising students interested in graduate study with me, leading either to a Masters Thesis or a Doctoral Dissertation. While the effort and creativity required for a Doctorate is substantially greater, the philosophy behind the Thesis and the Dissertation is essentially the same.

Both efforts require substantial dedication of time. They should be viewed as professional activity, where the student is viewed as an apprentice practicing researcher. This is true regardless of whether the student is being funded or is paying their own way. However, *if the student is being funded then this funding requires significant efforts and progress for continuation of support.*

The process to achieving a completed Thesis or Dissertation has a number of purposes and goals. These are:

1. to expose the student researcher to the body of literature in the subject matter, and in related subjects, that are under study,
2. to permit the student researcher to evolve into an independent worker, who not only understands how to carry out tasks, but also how to initiate new avenues of work, and to develop characteristics which are necessary for professional success: *responsibility, initiative, carrying out tasks of all kinds to completion, and perseverance*, among others, and
3. to “create new knowledge” or to “apply existing knowledge in a new way”.

My role, as the advisor, will be to suggest possible research activities, generally in areas in which I currently am active or intend to become active. In addition, I will work in parallel with the graduate student, trying to answer questions, and to anticipate problems in the research. This will rarely work like clockwork, but progress is guaranteed given the necessary and appropriate efforts. Much of the burden of the day-to-day research will fall upon the student's shoulders, but, in various ways, I will also share this burden with you.

As my student, we will meet once a week, for about an hour, to discuss your progress and any questions that may have arisen as a result of your work. It is a good opportunity to discuss many things related to your studies at Rutgers. We can, of course, meet in addition to the regularly

scheduled time. But, I urge you to struggle with most difficulties before you come to me for assistance. This struggle is part of your research experience.

Rate of progress will be directly related to the amount of absolute time spent on this work by the student. Regular visits to the libraries (Math, Physics, Science and Medicine) and subscription to relevant online journals to keep up to date with the relevant journals, and books, are **mandatory**. While I have a good idea as to the literature, you must develop the same habits, and you are also likely to find relevant material that I did not find. One good reference can save months of a research effort. (Translate that into dollars.)

Stand-alone Masters Degrees will take between 1.5 and 2.5 years, depending on how early the student begins actual reading and research in the chosen technical area. Ph.D. research can generally be completed in 2-3 years of active work beyond the Masters. A student working on an integrated M.S.-Ph.D. can expect to complete both degrees in approximately 5 to 6 years, assuming the effort expended is of the quality and type described here.

Of course, much of this schedule depends on the number of hours spent by the student on all aspects of the work. I estimate that approximately 55 hours per week on average is required for good progress. This is between *5-6 days per week* of effort. **This is mandatory both for satisfactory progress as well as for continued financial support.** This is at least the level of effort that I also expend.

Remember, **one day per week** effort is equivalent to 15-20% of your time, or roughly **one year** of effort towards your Ph.D.

Generally, research will require an in-depth review of the literature, as well as a study of advanced topics. Ideally, this state-of-the-art review will be publishable in a scholarly journal. In addition, the review will suggest many possible deficiencies in current understanding and, thus, suggest many more research topics. Such a review will take at least 6 months of full time effort. Our intent is always to obtain a good physical understanding of the problem at hand. This understanding will help us decide on the proper mathematical tools for modeling the process, as well as what assumptions we can make so that the essential physics of the process are represented by a mathematical model which is tractable.

In addition to the review paper, it is expected that one or more papers will be publishable from the balance of the Dissertation research. Masters level work will generally result in one such publication.

The above are to be seen as general guides, and not as rigid rules. There are many ways to effectively study and do research. But the above procedure **will** work. Key elements to successful graduate study and research are **steady work, reading, and keeping tabs of the literature**. You are always encouraged to ask questions, whether of a technical or of a procedural nature.

Part of your research experience here involves working as part of a team. While your work is your own, *I strongly encourage you to work a good portion of your time at Rutgers*, even if you have your own home computer. This is why significant expense has been undertaken to provide you with excellent facilities. Interaction with your fellow students will teach you many important things, both technical and otherwise. In addition, you and I may need to meet spontaneously.

I will do whatever is necessary to make these years rewarding ones for each of my students.

Good luck in your research.