

AC 2007-886: DEVELOPMENT OF A GRADUATE COURSE IN NEUTRON INTERACTIONS AND THEIR APPLICATIONS IN NUCLEAR SCIENCE AND ENGINEERING

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Development of a Graduate Course in Neutron Interactions and their Applications in Nuclear Science and Engineering

Introduction

In the past decade there have been many new and improved applications in neutron science and engineering covering a wide array of topics. While there are still many detailed books on neutron transport and neutron physics, neutron radiography, neutron activation analysis and prompt-gamma activation analysis, little or no attention has been given to the development of a comprehensive graduate course encompassing the analytical applications of neutrons in the wide range of fields. This course was set up so that each graduate student would be responsible to prepare one-two week's worth of lectures on series of topics. This team design approach allowed a unique opportunity for graduate students to be involved in the educational process and gives them an understanding of the complexities of course preparation.

The course instructor was responsible to develop two of the subjects History of Neutron Research and Neutron Activation Analysis. The remainder subjects were divided among the eight graduate students including two distance learning ones. The subjects included Fundamental Principles of Neutron Interactions, Neutron Detection, Neutron Dosimetry, Boron Neutron Capture Therapy, Neutron Depth Profile, Neutron Radiography, Neutron Generation from Particle Accelerators, and Neutron Scattering.

Choice of Topics

The topics were chosen as to have a mixture of lectures written with expertise by the course instructor (History of Neutron Science and Neutron Activation Analysis) and graduate students who had completed Masters theses in two of the topics (Neutron Radiography and Neutron Depth Profile) with those subject matters developed for the first time by graduate students. Two topics in Fundamental Principles of Neutron Interactions and Neutron Detection were given to students who had undergraduate physics degrees and who naturally felt more comfortable with the content. One topic in neutron shielding and Monte Carlo methods was dropped since the distance learning graduate student decided to take the course as an independent study later on. Another topic of neutrons in space applications was also eliminated since the graduate student changed to another engineering field and no longer was in the program.

Criteria Used to Develop the Lectures

The lectures above all were developed in a rigorous manner and not to be of survey type quality. Each lecture was prepared to be a stand alone presentation and thus could be given in any order, with the exception of the first two, History of Neutron Science and Fundamental Principles of Neutron Interactions. There were several essential criteria agreed among the graduate students to develop the course. These conditions included:

- to have a common power point template
- to use of graphics and web related images
- to detail mathematical description of the various physical processes
- to use latest review articles if any – check the library resources not only the internet
- to provide at least ten solved problems to each set of notes
- to use references
- to convert specific articles to PDF for on-line usage
- to use animations where appropriate

The use of specific animations was developed with the course instructor who received a small grant from the University of Texas Faculty And Student Teams for Technology (FAST Tex) Program. Faculty members are awarded time to support “tech-savvy” students to build instructional technologies for use in UT Austin courses. The students in the resource pool come from a range of academic disciplines and are appointed, paid, and mentored by FAST Tex staff. Andrea Rudd from the Fine Arts Department was chosen to develop a series of animations for this course. She has had experience in developing animations in radiation biology and gamma-ray spectroscopy.

Solved Examples

Each student was required to come up with ten questions and answers for their specific topic. This exercise actually proved to be challenging to the students as well as being beneficial to the course itself.

Instructional Interaction

The face to face instructional interaction was limited. Only three lectures were given between the instructor and the graduate students. For the first lecture the course requirement and outcomes were presented by the course instructor. In the second lecture each student was required to give an outline for two lecture series in front of the class. After the first lecture was developed each student uploaded his work to the Blackboard Instructional web site and the instructor read over each lecture in great detail. For the third lecture the instructor quickly went over recommended changes for each lecture and how to implement these changes for the second lecture. At the end of the semester all the lectures were once again uploaded to the web site and graded for content, style, use of graphics and images and preparation of questions.

Further Evaluation

In the 2007 spring semester the on campus graduate students presented their first lecture in the seminar class offered by another faculty member. This allowed them the opportunity to have experience in presenting a full lecture instead of the usual 15 minute presentation at conferences. This also gave the students an opportunity to self evaluate their own work and compare it to their peers.

Conclusions

This is first attempt in the Nuclear and Radiation Engineering Program at the University of Texas to have graduate students be involved in the development of a course. The material from this course can now be expanded by the instructor for future offerings. The students enjoyed the opportunity to be involved in such a innovative venture and allowed them to appreciate the enormous time and commitment that professors give to developing any course.