Expanded Course Description
Nuclear Engineering 290D
Analytical Methods for Non-Proliferation

Course Summary

Laboratory and lecture. Use of nuclear measurement techniques to detect clandestine movement and/or possession of nuclear materials by third parties. Course will involve on-site experiments conducted at a national laboratory facility. Guest lecturers from national laboratories and academic institutions will describe the state of the art in analytical techniques and measurement capabilities. Students must be willing to attend lectures and laboratory at a remote site for one week. Students should be familiar with alpha, beta, gamma, and neutron radiation and basic concepts of nuclear fission.

Method of Instruction

The first week of the course will be given at a national laboratory facility. The course activity runs all day for a five-day week. Lectures are given by professional scientists working on nonproliferation subjects within the national laboratories. The lectures comprise roughly the first half of each day. Afternoon sessions involve experimental work using developed proliferation detection technologies using radiography, tracer gas detection, gamma ray spectroscopy, and neutron interrogation methods. Students will be required to keep a laboratory notebook for the experimental activities and to answer some short quizzes on the lecture material presented.

The second week will take place on the Berkeley campus for five three-hour lecture and discussion sessions over a one week period. During this period, the students will perform a design study for a particular proliferation detection scheme. The design study may contain some quantitative assessment using the nuclear spectroscopy instructional equipment and radiation sources available in the Nucleonics Laboratory on the Berkeley campus, as well as computer modeling tools available at the Nuclear Engineering Computational Laboratory. The students will present a project report on this course component in both written and oral form.

Method of Evaluation

Instructors at the national laboratory site will be asked to complete an evaluation form for each student in the course, including questions about the student's performance

on quizzes and on laboratory work. The quizzes will also be available to the instructor of record for the course. The students will also submit their logbooks for laboratory and field work to the instructor at UCB. The students will also be graded on the quality of their written and oral presentations during the design segment of the course conducted at UCB. Grading will be 35 % for the final written report, 15 % for the oral presentation, 25 % for laboratory notebooks, and 15 % for offsite instructor evaluations.

Enrollment Requirements

Enrollment is normally restricted to students with graduate standing in Nuclear Engineering at UCB but may be waived by consent of the instructor. Enrollment is limited to regular full-time students at UCB.

Issues Related to Field Work

Because of security requirements at the national laboratory site, students will be required to submit personal information to the national laboratory host in order to gain admission to the site for the first week's activity. In the event of a registered student failing to gain permission to the national laboratory site, the student may arrange with the instructor for a more in-depth experimental project to be performed on the UCB campus using open facilities.

Syllabus

Day	**Week**	**Lecture Topics**
		Week 1: Field Program
1	1	Course Introduction Overview of WMD U.S. Nonproliferation Program IAEA Nonproliferation program Nuclear Fuel Cycles and Wastes Gamma and Neutron Detection with MCA Emergency Response Systems Airborne and Standoff Surveillance Weapons Test Attribution
2	1	Historical Nonproliferation Efforts Current Treaties concerning Nonproliferation Chemical Warfare Agents The PINS System Safety Training for PINS Experiments Laboratory: The PINS System for Chemical Warfare

		Agent Detection
3	1	Nuclear Weapons Testing Worldwide Radioactive Fallout and Debris Automated Airborne Radioactive Monitoring Customs Inspection and Border Surveillance Laboratory: RASA, ARSA, and R-TARAC
4	1	Radiation Detection Neutron Radiography Laboratory: Thermal Reactor and Neutron Generator Laboratory: Gamma Activation of Aluminum Laboratory: Transuranic Detection in Drums using Gamma Radiography
5	1	Nuclear Forensics and Attribution Nuclear Triage Livermore and Los Alamos Programs (TBA) Future Needs
		Week 2: On-Campus Program
1	2	Safety Issues at Nucleonics Lab Overall Design Concepts for Non-proliferation Instrumentation
2	2	Principles of Detection System Evaluation Counting Statistics Probabilistic Analysis
3	2	Case Studies in Nonproliferation Technology Monte Carlo Simulation Analytical Neutronics Evaluation
4	2	Design Project Discussions Laboratory Assessment of Design Project
5	2	Design Project Presentation Course Review