

**Syllabus for Nuc Eng 290E,
Special Topics in Environmental Aspects of Nuclear Engineering**

Fall 2014

3 Units

Tuesdays and Thursdays, 12:30 – 2:00 pm
140 Barrows Hall

Instructors

Prof. Joonhong Ahn, 4165 Etcheverry Hall, 642-5107, ahn@nuc.berkeley.edu

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Catalog description

Lectures on special topics of interest in environmental impacts of nuclear power utilizations, including severe accidents. The course content may vary from semester to semester, and will be announced at the beginning of each semester.

Course prerequisites

Basic knowledge on transport phenomena and nuclear power systems.

Course objective

This course covers various environmental issues that are resulted from nuclear power utilization, including legacy waste issues from weapons production, airborne/subsurface contamination from nuclear disasters, and issues related to uranium mining as well as geological disposal of radioactive wastes and spent nuclear fuels. Forefront researchers of respective fields are invited to give omnibus lectures and suggest materials for further studies.

Course outline

1. Overview for Environmental Issues in Nuclear Power Utilization
2. Processes for Radioisotope Transport in Environmental Systems
 - (i) Overview
 - (ii) Reactive chemistry of relevant radioisotopes in the environment
 - (iii) Watershed-scale understanding of water flow and reactive transport of radioactive contaminants in the environment
 - (iv) Molecular scale understanding of radioactive transport and sorption
 - (v) Biosphere transport processes with compartment models
3. Data Management and Visualization
 - (i) Radiation monitoring and data processing
 - (ii) Geostatistics on complex environmental datasets

4. Case studies (I)
 - (i) Fukushima Daiichi accident
 - (ii) Chernobyl accident
 - (iii) Uranium solution mining and mine tailings
 - (iv) Hanford

5. Relevant issues and processes for Geologic Disposal of Radioactive Waste
 - (i) Overview of
 - (ii) Geologic considerations, siting, and analogs
 - (iii) Coupled processes in engineered and natural barriers
 - (iv) Transport of radionuclides in geosphere and biosphere
 - (v) Site characterization
 - (vi) Underground Research Lab Field testing

6. Case studies (II)
 - (i) USA - Yucca Mountain
 - (ii) USA – WIPP, a salt host rock repository
 - (iii) Sweden and Finland – Crystalline host rocks

References

Powerpoint slides are uploaded to the class “bspace”. In addition, a list of further reading materials will be provided in each set of powerpoint slides.

Grading

- (1) Homework sets (30%)
- (2) Mid term exam (25%)
- (3) In-class discussions (15%)
- (4) Term project (30%)

Students are required to select one reference from the list of further reading materials provided by each lecturer, and join in-class discussions. A written exam is given as the mid-term exam in the middle of the semester to evaluate their understanding of topics discussed in the class. Each student is required to explore one topic of interest as a term project, for which a written report need to be submitted.

Class Schedule

Week	Topics	Lecturers
8/28	1 Overview	Ahn
9/2 9/4	2(i) Overview relevant issues and processes Discussions	Hubbard Ahn
9/9 9/11	2.(ii) Reactive chemistry 2.(iii) Large-scale transport	Nico Steefel
9/16 9/18	Discussions 2.(iv) Molecular scale transport	Bourg

9/23	2.(v) Biosphere transport	Ahn
9/25	2.(v) Biosphere transport	Ahn
9/30	3.(i) Radiation monitoring	Vetter
10/2	3.(ii) Geostatistics	Wainwright
10/7	3.(ii) Geostatistics	Wainwright
10/9	4.(i) Case Study: Fukushima	Ahn
10/14	4.(ii) Case Study: Chernobyl	Faybishenko
10/16	4.(iii) Case Study: Uranium solution mining	Williams
10/21	4.(iv) Case Study: Hanford	Faybishenko
10/23	Mid-term	
10/28	5.(i) Overview relevant issues and processes	Birkholzer
10/30	5.(ii) Geologic considerations	Dobson
11/4	5.(iii) Coupled processes	Birkholzer
11/6	5.(iv) Radionuclide transport	Ahn
(11/11)	No class	
11/13	5.(v) Site characterization	Daley
11/18	5.(vi) URL Field Testing	Birkholzer
11/20	5.(vi) Case Study: Claystone Repository	Birkholzer
11/25	Class project	
(11/27)	No class	
12/2	6.(i) Case Study: Yucca Mountain	Swift
12/4	6.(ii) Case Study: WIPP	Swift
12/9??	6.(iii) Case Study: Crystalline host rocks	Sjoeland
Final		

List of invited lecturers

Susan S Hubbard, Earth Sciences Division, LBNL <SSHubbard@lbl.gov>

Peter S Nico, Earth Sciences Division, LBNL <PSNico@lbl.gov>

Carl I Steefel, Earth Sciences Division, LBNL <CISteefel@lbl.gov>

Ian C Bourg, Earth Sciences Division, LBNL <ICBourg@lbl.gov>

Kai Vetter, Nuclear Science Division, LBNL <KVetter@lbl.gov>

Haruko Murakami Wainwright, Earth Sciences Division, LBNL <HMWainwright@lbl.gov>

Boris A Faybishenko, Earth Sciences Division, LBNL <BAFaybishenko@lbl.gov>

Kenneth Hurst Williams, Earth Sciences Division, LBNL <KHWilliams@lbl.gov>

Patrick (Pat) Dobson, Earth Sciences Division, LBNL <PFDobson@lbl.gov>

Tom Daley, Earth Sciences Division, LBNL <tmdaley@lbl.gov>

Peter Swift, Sandia National Laboratories <pnsswift@sandia.gov>

Anders Sjoeland, Swedish Nuclear Fuel and Waste Management Co. (SKB)