Introduction to Nuclear Materials

NE 209

Fall 20XX

Tues./Thurs. 11:45AM-1:00PM

XXX Burlington

1. **Instructor**

Dr. Benjamin Beeler

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Office Hours: Wed. 10:15-11 am

1. **Course Overview**

*In this course we will study the behavior of nuclear materials in advanced reactor environments. Students will be introduced to different advanced reactor systems and the materials that are either currently deployed, or plan to be deployed, within those reactors. Specific material phenomena and material evolution will be particularly emphasized, including, but not limited to: fission gas swelling, constituent redistribution, fission product attack, fission gas bubble superlattice, recrystallization, actinide salt chemistry, and radiation damage accumulation. A particular emphasis will be placed upon advanced fuel forms; however, this course will also address advanced cladding and coolant systems.*

1. **Learning Outcomes**

*By the end of this course, the student should be able to:*

1. *Identify key phenomena affecting the performance of advanced reactor materials*
2. *Understand the different stages of microstructural evolution in advanced reactor materials*
3. *Understand the role of reactor environment on material selection*
4. *Identify key areas delineating light water reactor and advanced reactor material evolution*
5. **Required Text(s)**

None.

Supplemental texts:

Introduction to Materials Science for Engineers, J. Shackelford

Fundamentals of Radiation Materials Science, G. Was

An Introduction to Nuclear Materials, K. Murty and I. Charit

Comprehensive Nuclear Materials, R. Konings

1. **Course Requirements**

Examinations: 4 @ 20% each

Homework: 20%

1. **Topical Outline:**

The below topical outline is a general, non-inclusive list of topics that can be covered within this course. This topic list is subject to change and is included to provide an example of topics of interest.

* 1. Introduction and Overview (1)
  2. Atomic Bonding (2)
  3. Crystal Structures (2)
  4. Defects (2)
  5. Diffusion (2)
  6. Mechanical Behavior (3)
  7. Thermal Behavior (2)
  8. Phase Diagrams (2)
  9. Radiation Damage (2)
  10. Radiation Effects (2)
  11. Materials Selection (3)
  12. Materials Research (1)

*Current total estimate: 24*

*Total lectures: ~30, 4 exams: 26 lectures*

1. **Grading**

Letter Grade Percent Grade

A+ 98-100; A 93-97; A- 90-92; B+ 87-89; B 83-87; B- 80-82; C+ 77-79; C 73-76; C- 70-72; D+ 67-69; D 63-66; D- 60-62; F Below 60