

**ENU 6805 Introduction to Nuclear Reactor Materials
Fall 2018, MWF 8:30-9:20AM, MAEB-234**

1. Catalog Description

This course provides a background on the types of materials used in nuclear reactors and their response to reactor environment. Many of the desirable material properties designed for nuclear reactor materials may degrade with exposure to the extreme environments (irradiation, temperature, stress, etc.) that are common to nuclear reactors. The objective of this course is to provide nuclear engineering students with background in materials and to discuss the unique challenges that occur in these materials under irradiation, so students understand the limitations put on reactor operations and design by materials performance.

2. Course Objectives

Successful students at the end of the course will have:

- A basic understanding of the relationship between material microstructure and macroscopic behavior of materials.
- An overall view of the materials used in nuclear power reactors, and an understanding of the basic mechanisms of materials degradation induced by neutron irradiation and the reactor environment including processes such as swelling, creep, phase transformations, embrittlement, and radiation induced segregation.
- The overall objective of the course is to enable the students (the majority of which may work directly in the nuclear materials area in the future) to understand the issues associated with materials degradation in nuclear reactors and be able to discuss said issues with others who do not have the appropriate background.

3. Instructor

Dr. Assel Aitkaliyeva
Assistant Professor, Materials Science and Engineering
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352-846-3778
aitkaliyeva@mse.ufl.edu
Office Hours: Mondays 9:30am-11:30am

4. Teaching Assistant

N/A

5. Meeting Times

M, W, F: Period 2 (8:30-9:20AM)

6. Class Schedule

Three lecture periods per week, one period each on Monday, Wednesday, and Friday.

7. Meeting Location

MAEB, Room 234

8. Material and Supply Fees

N/A

9. Textbooks Required

None required. Course notes and suggested reading material will be provided through Canvas.

10. Recommended Reading

Recommended Materials to Assist with Understanding Course Objectives

- Fundamentals of Radiation Materials Science, G. Was
- Fundamental aspects of nuclear reactor fuel elements, D. R. Olander
- Nuclear Reactor Materials and Applications by B. Ma

Recommended Texts and Support to Assist with Writing Assignments

- The Mayfield Handbook of Technical and Scientific Writing (available at <http://www.mhhe.com/mayfieldpub/tsw/toc.htm>). *Excellent resource and free!*
- The University of Florida Reading and Writing Center is also available to help students become better readers and writers. More information (including operating hours) can be found at <http://www.at.ufl.edu/rwcenter>.

11. Course Outline

The following topics will be covered in the course:

Overview:

- Course introduction
- Introduction to nuclear materials

Fundamental materials science:

- Introduction to materials science
- Crystal structures
- Point defects
- Line defects
- Volume defects
- Diffusion
- Phase diagrams

Radiation damage:

- Damage cascades
- Displacement energies, collision theory, energy loss
- Displacement cross-sections
- SRIM, range, damage
- Ion vs. neutron damage
- Microstructure evolution

Mechanical properties:

- Creep
- Hardening
- Toughness

Fuel:

- Chemistry, fabrication, failure
- Microstructural changes
- Fission products
- Swelling
- Property changes

Other issues:

- Hydriding
- Corrosion
- Accident behavior

Note: Course schedule may also change due to my unscheduled travel. I reserve the right to hold make-up classes if necessary (for example, in case of class cancellations due to weather). No classes will take place on September 12th and October 17th due to scheduled travel.

12. Attendance and Expectations

Proper behavior in class is always important and leads to a relaxed and productive educational environment. Thus, eating, drinking, texting, reading of newspapers, working on homework for this or other courses, or other activities that are not part of the class are not allowed. Students who do not comply with these requirements or who behave disorderly or disrespectfully may be asked to leave the classroom. Leaving your cell phone on, leaving early or arriving late can be VERY distracting. All electronic devices (PDAs, cell-phones, etc.) should be turned off or in silent mode. If your cell phone rings during class, it will be confiscated for the remainder of the class period. Students MUST participate during the student presentations at the end of the course in order to successfully complete the course. While not directly enforced, attendance is strongly suggested since significant amount of participative as well as individual and collaborative work will be performed during the class sessions.

13. Grading

Video entries	10%
Writing assignment 1	30%
Review panels	10%
Writing assignment 2	30%
Oral presentation	20%

Video entries

Video submissions are due by 5 PM on assigned date. Entries submitted after 5 PM on the due day will be considered as submitted the next day. Late submissions will receive a penalty of 10% per day late. Entries submitted after one week after the due date will not be accepted.

Writing assignment 1

First writing assignment consists of three parts: two separate whitepapers and a full proposal. You will have 2 weeks to write a whitepaper and 4 weeks to write a

full proposal. Requirements for all written submissions are as follows: 3 pages in length maximum; min font size of 11, font: Times New Roman or Arial; alignment: justified. Inability to follow guidelines will result in significant point deduction. Submissions are due by 5PM on assigned date and submissions received after 5PM will receive 10% penalty. More information on the assignment will be provided before tasks are assigned.

Review panel

Students will participate in two panels, where they will be tasked with reviewing all submitted proposals. Participation in review panels is mandatory and worth 10% of the final grade.

Writing assignment 2

Second writing assignment will consist of writing a review manuscript for a scientific journal. Substantial penalties will result from plagiarism including automatic course failure and possible expulsion. Grades for the final design manuscripts will be based upon (1) technical content, and (2) writing style. Students are asked to prepare their papers according to the author instructions for the Journal of Nuclear Materials (but others mentioned in the recommended reading are acceptable too).

Students are asked to follow the instructions to the letter, except for the following:

- Limit your total number of pages of text (Abstract to Conclusions) to no more than 15 pages and no fewer than 10 pages. (single spaced)
- Submit only one copy of the Manuscript (including all tables and figures) in pdf format. MS word is also acceptable, but you are held responsible for any formatting changes between computers that can happen with Word.
- Each paper must have at least four tables and figures (combined).
- Each paper must have at least 5 peer-reviewed journal article citations (beyond textbooks or conference proceedings).

Each manuscript will be submitted with a cover letter to the appropriate Editor-in-Chief noting why you think your work is worthy of publication. Final manuscripts from all groups are due by email on **November 26th by 5:00 PM**. Late submissions will receive a penalty of 10% per day late. Manuscripts submitted after 5:00 PM on the due day will be considered as submitted the next day.

Oral Presentation

Starting from November 28th we will meet during our normal class schedule to hold oral presentations on your assigned projects. Each presentation will be limited to 12 minutes with 1-3 minutes for questions. Presentations need to be sent to the instructor at least a day before your presentation date so they can be uploaded. Presentations sent on the day of the presentation will receive a penalty of 10%.

14. Grading Scale

The grading scale is generally as follows:

Percent	Grade
93-100	A
90-92	A-
87-89	B+
83-86	B
80-82	B-
77-79	C+
73-76	C
70-72	C-
67-69	D+
63-66	D
60-62	D-
0-59	E

For more information on grades and grading policies, please visit:
<http://www.registrar.ufl.edu/catalog/policies/regulationgrades.html>”

15. Make-up Exam Policy

Make-up Exams and Laboratory Experiments are only allowed through prior requests or DOCUMENTED medical reasons. In cases where students will be out of town, a reasonable attempt to take the exam before the scheduled exam date will be performed.

16. Students Requiring Accommodations

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, <https://www.dso.ufl.edu/drc>) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

17. Course Evaluation

Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at <https://evaluations.ufl.edu/evals>. Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at <https://evaluations.ufl.edu/results/>.

18. University Honesty Policy

UF students are bound by The Honor Pledge which states, “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” The Honor Code (<https://www.dso.ufl.edu/sccr/process/student->

conduct-honor-code/) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor.

19. Software Use

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

20. Student Privacy

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <http://registrar.ufl.edu/catalog0910/policies/regulationferpa.html>

21. Campus Resources:

Health and Wellness

U Matter, We Care:

If you or a friend is in distress, please contact umatter@ufl.edu or 352 392-1575 so that a team member can reach out to the student.

Counseling and Wellness Center: <http://www.counseling.ufl.edu/cwc>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Assault Recovery Services (SARS)

Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

Academic Resources

E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu. <https://lss.at.ufl.edu/help.shtml>.

Career Resource Center, Reitz Union, 392-1601. Career assistance and counseling. <https://www.crc.ufl.edu/>.

Library Support, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring. <https://teachingcenter.ufl.edu/>.

Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers. <https://writing.ufl.edu/writing-studio/>.

Student Complaints Campus:

https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf.

On-Line Students Complaints: <http://www.distance.ufl.edu/student-complaint-process>.