

# Introduction to Nuclear Reactor Materials

EGN 4800 Section 06FA

**Class Periods:** M W F, 6, and 12:50-1:40PM

**Location:** MAEB 229

**Academic Term:** Spring 2017

## **Instructor:**

Yong Yang

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352-846-3791

Office Hours: Walk-in or appointment by email

## **Teaching Assistants:**

Please contact through the Canvas website

N/A.

## **Course Description**

Introduction to the materials used in nuclear energy systems and their response to the reactor environment. The majority of materials related issues encountered in the nuclear power plants are discussed in this course.

## **Course Pre-Requisites / Co-Requisites**

None.

## **Course Objectives**

To provide the students with a comprehensive knowledge on the types of materials used in nuclear reactors, their response to the reactor environments and most of the materials problems encountered in the operation of nuclear power reactors for energy production.

## **Materials and Supply Fees**

None.

## **Professional Component (ABET):**

This course provides 3 credits towards Engineering Sciences, and Students are required to apply advanced mathematics, science, and engineering science, including atomic and nuclear physics, and interaction of radiation with matter to understand and solve the issues of the radiation damage induced material degradations including volumetric swelling, radiation hardening and embrittlement, and elemental segregations in nuclear structural and fuel materials.

Does this course contain design experience? Yes, a small amount.

## **Relation to Program Outcomes (ABET):**

The table below is an example. Actual outcomes will vary by program. Below is applicable only to MSE.

Outcome	Coverage*
a. an ability to apply knowledge of mathematics, science, and engineering	High
b. an ability to design and conduct experiments, as well as to analyze and interpret data	
c. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	
d. an ability to function on multidisciplinary teams	
e. an ability to identify, formulate, and solve	

engineering problems	
f. an understanding of professional and ethical responsibility	
g. an ability to communicate effectively	
h. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	
i. a recognition of the need for, and an ability to engage in life-long learning	High
j. a knowledge of contemporary issues	High
k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.	

\*Coverage is given as high, medium, or low. An empty box indicates that this outcome is not part of the course.

### **Required Textbooks and Software**

No required textbook, and the course notes will be provided through Canvas.

### **Recommended Materials**

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

### **Course Schedule**

#### **Overview:**

- 1. Course Introduction
- 2. Materials in Nuclear Reactor

#### **Basis of Materials:**

- 3. Crystal structures
- 4. Point defects in solids
- 5. Diffusion
- 6. Dislocation and grain boundary

#### **Radiation damage:**

- 7. Collision theory, Cross sections, Energy loss
- 8. SRIM, Range, Damage
- 9. Ion, Neutron damage
- 10. Microstructural development

#### **Fuel:**

- 11. Chemistry, fabrication, failure
- 12. Fission products
- 13. Swelling

#### **Mechanical performance:**

- 14. Creep
- 15. Hardening
- 16. Toughness

#### **Corrosion:**

- 17. Thermodynamics
- 18. Kinetics
- 19 Corrosion in nuclear fuel

## ***Attendance Policy, Class Expectations, and Make-Up Policy***

Proper behavior in class is required, eating, texting, chatting, 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. Cell phones and other electronic devices must be completely silent or turned off.

Attendance is required and will be monitored using sign up sheets, and your attendance records will be available on Canvas. Five or more un-excused absences will result in a deduction of 20 points from your final grade.

Excused absences are consistent with university policies in the undergraduate catalog (<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>) and require appropriate documentation.

## ***Evaluation of Grades***

<b>Assignment</b>	<b>Total Points</b>	<b>Percentage of Final Grade</b>
Homework Sets (4)	100 each	40%
In Class Exam #1	100	20%
In Class Exam #2	100	20%
In Class Exam #3	100	20%
		100%

## ***Grading Policy***

<b>Percent</b>	<b>Grade</b>	<b>Grade Points</b>
96 - 100	A	4.00
91 - 95	A-	3.67
86 - 90	B+	3.33
85 - 81	B	3.00
80 - 76	B-	2.67
75 - 71	C+	2.33
70 - 66	C	2.00
76 - 65	C-	1.67
64 - 62	D+	1.33
61 - 59	D	1.00
58 - 56	D-	0.67
0 - 55	E	0.00

More information on UF grading policy may be found at:

<https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

## ***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.

## ***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/>.

### ***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 or TAs in this class.

### ***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.

### ***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>

### ***Campus Resources:***

#### *Health and Wellness*

#### **U Matter, We Care:**

If you or a friend is in distress, please contact [umatter@ufl.edu](mailto: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](mailto: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](https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf).

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