

EEE 460 NUCLEAR CONCEPTS FOR THE 21ST CENTURY

Instructor: Dr. Keith E. Holbert E-mail: Holbert@asu.edu
Office Hours: MW, 9:30–11:00 a.m. and Tu, 1:30–3:00 p.m. in ERC 581; (480) 965-8594

Class Meeting Info: MW, 3:15–4:30 p.m. in SCOB 101
Semester Exams: Scheduled for February 18 and March 31
Final Exam: Tuesday, May 6, 2008 from 10:00–11:50 a.m.

Textbook: J. K. Shultis and R. E. Faw, *Fundamentals of Nuclear Science and Engineering*, 2nd ed., CRC Press, 2008.

Course Webpage: <http://www.eas.asu.edu/~holbert/eee460/eee460.html>
Lecture slides and homework solutions available at myASUcourses

Course Objective: Provide students with an understanding of the multidisciplinary applications of nuclear concepts in the engineering profession.

The corresponding Course Outcomes are

- Students will have usable knowledge of the physics behind nuclear concepts
- Students will understand the effects and uses of radiation
- Students will understand the principles of power generation via nuclear processes

Course Description: Radiation interactions, damage, dose, and instrumentation. Cosmic rays, satellite effects; soft errors; transmutation doping. Fission reactors, nuclear power. TMI, Chernobyl. Radioactive waste. Prerequisites: CHM 114 (or 116); MAT 274 (or 275); PHY 241 (or 361).

Topics: Broken into three basic divisions for the semester as given below:

- I. Basic Physics (Chaps. 1–6)
- II. Radiation Effects (Chaps. 7, 9; web documents)
- III. Nuclear Power (Chaps. 10–12)

Grading

“Standard” scale (with \pm) using 90-100 "A", 80-90 "B", 70-80 "C", etc.

Homework	30%
Semester Exams (2)	40%
Final Exam	30%

Homework: The homework assignments will be posted on the course webpage. Homework is expected to be turned in on-time, which is defined as before the start of class on the due day. Presentation and methods for arriving at the answer are just as important as the mathematical answer; solutions should be neat and logical. For complete credit: (1) show all work, and (2) box the answer and include the units. Students may work together on the homework, but copying is unacceptable: the ASU *Academic Integrity Policy* (AIP) is incorporated herein by reference.

EEE 460 SEMESTER TEACHING PLAN

(MW, Spring 2008)

The textbook sections (given in parenthesis below) should be read **before** the class meeting that day.

Week	Date	Lecture Topic	Homework
1	1/14	Introduction; Atoms and Nuclei; Number Density (1.1→1.3)	
	1/16	Relativity; Photons (2.1→2.2); Atomic–Nuclear Models; Nuclear Stability (3.1→3.2)	Hmwk #1 Due
2	1/21	### MLK Holiday ###	
	1/23	Binding Energy; Nuclear Reactions; Q-value (4.1→4.7)	
3	1/28	Radioactive Decay; Decay Law; Activity; Transmutation (5.1→5.5)	Hmwk #2 Due
	1/30	Decay Chains; Natural Radioactivity; Compound Decay (5.6→5.9)	
4	2/ 4	Binary Reactions (6.1→6.4)	Hmwk #3 Due
	2/ 6	Neutron Reactions; Fission; Fusion (6.5→6.7)	
5	2/11	EXTRA: Space Radiation Environment; Soft Errors	Hmwk #4 Due
	2/13	Review for Exam #1	
6	2/18	*** Exam #1 ***	
	2/20	Attenuation; Flux; Cross-sections; Reaction Rates; Point Source (7.1→7.2)	
7	2/25	Photon Interactions; Neutron Interactions (7.3→7.4)	Hmwk #5 Due
	2/27	Charged Particle Interactions (7.5)	
8	3/ 3	Radiation Dose; Dose Units; Exposure; Biological Effects (9.1→9.4)	Hmwk #6 Due
	3/ 5	EXTRA: Radiation Effects on Materials; Displacement Damage	
### SPRING BREAK ###			
9	3/17	EXTRA: Total Ionizing Dose	Hmwk #7 Due
	3/19	EXTRA: Single Event Effects	
10	3/24	EXTRA: Spacecraft Charging	Hmwk #8 Due
	3/26	Review for Exam #2	
11	3/31	*** Exam #2 ***	
	4/ 2	Moderation; Nuclear Fuel; Criticality; Multiplication Factor; Four Factor Formula (10.1→10.5)	
12	4/ 7	Reactor Kinetics; Delayed Neutrons; Reactor Dynamics; Reactivity Feedback (10.6→10.8)	
	4/ 9	Electric Power Generation; PWRs; BWRs (11.1→11.5)	Hmwk #9 Due
13	4/14	Nuclear Fuel Cycle; Nuclear Waste and Disposal (11.6)	
	4/16	Fusion (12.1→12.3); Space Reactors (12.10)	Hmwk #10 Due
14	4/21	Thermoelectric Generators; Thermionics; Direct Energy Conversion; Radioisotopic Power Sources (12.4→12.5, 12.8→12.9)	
	4/23	EXTRA: Three Mile Island; Chernobyl	Hmwk #11 Due
15	4/28	Review for Final Exam	
	4/30	--- Reading Day ---	
	5/ 6	*** Final Exam ***	

Email: Important information may be sent to students via their ASU email account. Be sure to read your ASU email or forward it to an email account that you do read regularly.

Conduct: Thank you in advance for adhering to the ASU *Student Code of Conduct* and preventing *disruptive classroom behavior*, such as cell phone ringing, arriving late to class, and irrelevant side conversations.