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## KANSAS STATE UNIVERSITY

### Elements of Nuclear Engineering UEA – 500, KSU - NE495

**Prerequisites** MATH 221 (Calculus II or knowledge of integral and differential calculus) and PHYS 213 (Engineering Physics I or knowledge of calculus-based classical physics) or permission of the instructor.

#### Instructor

Dr. William Dunn

Kansas State University

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Official office hours: message board, e-mail, or telephone

#### Description and Goals

After completing this course, you should be able to:

1. Explain a variety of nuclear phenomena using concepts of modern physics
2. Estimate magnitudes of atomic and nuclear properties from macroscopic data
3. Calculate nuclear reaction energetics from atomic mass data
4. Predict properties of radioactive materials
5. Design and analyze various applications of radioactivity
6. Describe characteristics of charged-particle, photon and neutron interaction with matter
7. Quantify attenuation of and reaction rates for neutral radiation particles
8. Assess efficacy of different radiation protection techniques
9. Calculate doses, infer subsequent health risks to humans, and assess compliance to standards
10. Describe and quantify the neutron cycle in a reactor
11. Expound on the many uses of nuclear technology in society
12. Elucidate, in words a liberal-arts graduate could understand, the importance or physical meaning of nuclear jargon terms introduced in the course, such as flux, decay constant, binding energy, thermal utilization, etc.

#### Required Text

J.K. Shultis and R.E. Faw, Fundamentals of Nuclear Science and Engineering, 2<sup>nd</sup> edition, ISBN: 978-1-4200-5135-3, CRC Press, Boca Raton FL, 2008.

Publisher: CRC Press

**Topics:**

1. Introduction (0.3 week)
2. Basic Atomic and Nuclear Physics (3 weeks)
3. Radioactivity (1.7 weeks)
4. Nuclear Reactions (1.3 weeks)
5. Radiation Interaction with Matter (1.7 weeks)
6. Radiation Detection, Dosimetry and Risk Assessment (2.3 weeks)
7. Nuclear Reactors (2 weeks)
8. Applications of Nuclear Technology (2 weeks)

Although electronic versions may suffice, note that exams are open book. Errata are available from: <http://www.mne.ksu.edu/~jks/books.htm>. Supplemental materials will be made available electronically when needed.

**Course Policies and Administration****1. Homework**

There will be five homework assignments, each worth 50 points. You may work with others on the solutions but each person should prepare his or her own write-up and scan into a PDF file. Sign the cover sheet; this signature indicates compliance with the Honor system described below. Drop the PDF file in the drop box on the K-State Online web site by the date indicated on the course schedule.

**2. Preparation for Class**

Please complete the reading assignment before viewing the lecture for the class. In addition, there will be one on-line experiment in which we will determine the half-life of a radioisotope. You are to write a short summary of your findings and submit this through the drop box on the course web site. This write-up will be worth 50 points

**3. Examinations**

There will be a mid-term examination (worth 300 points) during the semester and a final examination (worth 400 points).

**4. Grades**

A score will be determined on the basis of homework (250 points), the half-life experiment write-up (50 points), and examinations (700 points), for a total of 1,000 points.

Mon 05/04	39	14	Medical applications of radiation. [Tentative] <b>HW 6 DUE.</b>
Wed 05/06	40	13, supplement	Radiation applications in agriculture and industry. [Guest lecturer: Dr. J.S. Smith]
Fri 05/08	41	everything	Course summary and final review. [Tentative]
Tue 05/12			<b>FINAL EXAM. 11:50 AM—1:40 PM in normal</b>

### Statement Regarding Academic Honesty

Kansas State University has an Honor System based on personal integrity which presumes sufficient assurance that, in academic matters, one's work is performed honestly and without unauthorized assistance. Undergraduate and graduate students, by registration, acknowledge the jurisdiction of the Honor System. The policies and procedures of the Honor System apply to all full and part-time students enrolled in undergraduate and graduate courses on-campus, off-campus, and via distance learning. The honor system website can be reached via the following URL: [www.ksu.edu/honor](http://www.ksu.edu/honor). A component vital to the Honor System is the inclusion of the Honor Pledge which applies to all assignments, examinations, or other course work undertaken by students. The Honor Pledge is implied, whether or not it is stated: "On my honor, as a student, I have neither given nor received unauthorized aid on this academic work." A grade of XF can result from a breach of academic honesty. The F indicates failure in the course; the X indicates the reason is an Honor Pledge violation.

### Statement Regarding Students with Disabilities

Students with disabilities who need classroom accommodations, access to technology, or information about emergency building/campus evacuation processes should contact the Student Access Center and/or their instructor. Services are available to students with a wide range of disabilities including, but not limited to, physical disabilities, medical conditions, learning disabilities, attention deficit disorder, depression, and anxiety.

Manhattan or Olathe campuses: [accesscenter@k-state.edu](mailto:accesscenter@k-state.edu), 785-532-6441

Salina campus: [acac@k-state.edu](mailto:acac@k-state.edu), 785-826-2649.