

SYLLABUS

Catalog number: **HEHT540**

Title: **Principles of Radiation Science**

Term: **Spring 2009**

Call number: **4015**

Locations:

Most lectures as well as the exams are given in Room C530, Wadsworth Center, New York State Department of Health, Empire State Plaza, Albany, NY 12201. Selected lectures (see detailed schedule) are given at SUNY East Campus, One University Place, Rensselaer, NY 12144, Room A217. A convenient SUNY bus schedule is provided between the two locations (call 402-0283 for details).

Meeting times: Tuesdays and Thursdays 3:30 - 5:00 pm

Instructors:

Assist. Prof. Ilham Almahamid, Dr. Abdul Bari, Mr. Clayton Bradt, Prof. David Carpenter, Dr. Abdul J. Khan, Assist. Prof. Michael Kitto, and Assist. Prof. Thomas Semkow.

Course Director contact information:

Thomas Semkow, room D486C, phone 474-6071, email tms15@health.state.ny.us, office hours Mon – Fri, 9 am – 5 pm or by appointment.

Listing:

Fundamentals of radioactivity and nuclear transformations, interaction of ionizing radiation with matter, biological effects of radiation, radiation dosimetry and protection, radiation and public health, uses and applications of radionuclides in medicine, energy, chemistry, and environment.

Description:

The risk from ionizing radiation has been traditionally a part of public health. We are faced with an unavoidable natural radiation dose and are concerned with the uses of ionizing radiation such as in medicine and energy generation. This course gives a comprehensive and balanced views of ionizing radiation as appropriate for the School of Public Health students. The course consists of 8 topics. Midterm exam is scheduled after topic 5.

Topics 1 – 5 are devoted to the basic radiation science. After an introduction, basic families of elementary particles, types of ionizing radiations, and radioactive decay are described. Interactions of principal components of ionizing radiation with matter are described. Topic 4 uses some differential equations and statistical distributions. However, no such derivations will be required on the exams.

Topics 6 and 7 cover radiation protection. Internal and external dosimetry are discussed including approved by law limits of exposure. The biological effects, including cellular and molecular processes, are covered.

Topic 8 is devoted to public health as well as the uses of ionizing radiation. Important and often misunderstood issues are covered, such as medical applications, nuclear energy, nuclear accidents, nonionizing radiation, food irradiation, as well as radioactive waste. Health effects of radon are described. Nuclear proliferation and terrorism are discussed.

Learning objectives (competencies):

- Gaining basic knowledge in radiation science
- Understanding of ionizing radiation as a public-health risk and how to approach it
- Develop concepts on how ionizing radiation is used in other fields
- Prepare students for HEHT541: Radioactivity Measurements Laboratory

Prerequisites: college-level courses in physics, chemistry, biology, and calculus

Credits: 3

Minimum number of students: 2

Grading policy:

A – C passing, E failing (no D grade). $A \geq 95\%$, $A- \geq 90\%$, $B+ \geq 85\%$, $B \geq 80\%$, $B- \geq 75\%$, $C+ \geq 70\%$, $C \geq 60\%$, $E < 60\%$.

Eight problem sets contribute to 50% of the total grade. Each problem set is due by the specified date. Late submission can only be justified on a basis of a serious personal emergency. Owing to the scheduling in such case, instructor may issue a substitute problem set. A midterm exam and a final exam contribute to the remaining 50% of the total grade. Each exam will test the knowledge of the corresponding ($\sim 1/2$) part of the course (no cumulative exams). All exams are open book.

Textbooks:

The required textbook is available from the SUNY Bookstore:

- W.D. Loveland, D.J. Morrissey, G.T. Seaborg. *Modern Nuclear Chemistry*. Wiley & Sons (2006).

Lecture notes may be handed out to the students. Numerical tables are provided. Selected sections from the following books may be assigned.

- G. Friedlander, J.W. Kennedy, E.S. Macias, J.M. Miller. *Nuclear and Radiochemistry*. Wiley & Sons (1981).
- H. Cember, T.E. Johnson. *Introduction to Health Physics*. McGraw-Hill (2009).
- J.E. Coggle. *Biological Effects of Radiation*. Taylor & Francis (1983).
- M. Eisenbud, T. Gessell. *Environmental Radioactivity*. Academic Press (1997).

Schedule by topic:

Topic #	Topic title	Content	# of classes	Date
1	Introduction	Radioactive decay and units, natural and artificial radioactivity. Historical account.	1	Thu Jan 22
2	Subatomic structure	Elementary particles and their interactions. Nuclear structure.	2	Tue Jan 27 Thu Jan 29
3	Radioactive decay and nuclear reactions	Alpha, beta, gamma, electron capture, internal conversion, Auger, x rays. Nuclear reactions.	4	Tue Feb 3 Thu Feb 5 Tue Feb 10 Thu Feb 12
4	Radioactive decay law and statistics	Exponential decay law, radioactive decay and growth, nuclear statistics.	3	Tue Feb 24 Thu Feb 26 Tue Mar 3
5	Interaction of radiation with matter	Photons, electrons, charged particles, heavy ions, neutrons.	2	Thu Mar 5 Tue Mar 10
	Midterm	exam	1	Thu Mar 12
6	Dosimetry and radiation protection	Units. Internal and external dosimetry. Annual limits of intake, exposure limits.	3	Tue Mar 17 Thu Mar 19 Tue Mar 24
7	Biological effects of radiation	Biological responses to radiation. Cellular and subcellular mechanisms.	2	Thu Mar 26 Tue Mar 31
8	Radiation and public health, applications of ionizing radiation	Medical applications. Nuclear power. Nuclear accidents: Chernobyl, TMI. Nonionizing radiation. Origin of chemical elements. Radon in environment and its health effects. Industry, chemistry, biology. Nuclear weapons, proliferation. Radioactive waste disposal.	1 1 1 1 2 1 1 1	Thu Apr 2 Tue Apr 7 Thu Apr 14 Thu Apr 16 Tue Apr 21 Thu Apr 23 Tue Apr 28 Thu Apr 30 Tue May 5
	Final	exam	1	Tue May 12

Schedule by date:

Date	Instructor	Topic	Location
Thu Jan 22	TS	1	Wadsworth
Tue Jan 27	TS	2	Wadsworth
Thu Jan 29	TS	2	Wadsworth
Tue Feb 3	TS	3	Wadsworth
Thu Feb 5	TS	3	Wadsworth
Tue Feb 10	TS	3	Wadsworth
Thu Feb 12	TS	3	Wadsworth
Tue Feb 24	TS	4	Wadsworth
Thu Feb 26	TS	4	Wadsworth
Tue Mar 3	TS	4	Wadsworth
Thu Mar 5	IA	5	Wadsworth
Tue Mar 10	IA	5	Wadsworth
Thu Mar 12	IA	Exam	Wadsworth
Tue Mar 17	CB	6	Wadsworth
Thu Mar 19	CB	6	Wadsworth
Tue Mar 24	CB	6	Wadsworth
Thu Mar 26	DC	7	East Campus
Tue Mar 31	DC	7	East Campus
Thu Apr 2	DC	8	East Campus
Tue Apr 7	DC	8	East Campus
Tue Apr 14	DC	8	East Campus
Thu Apr 16	AK	8	Wadsworth
Tue Apr 21	MK	8	Wadsworth
Thu Apr 23	MK	8	Wadsworth
Tue Apr 28	MK	8	Wadsworth
Thu Apr 30	MK	8	Wadsworth
Tue May 5	AB	8	Wadsworth
Tue May 12	MK	Exam	Wadsworth