

**ENERGY, POWER AND ENVIRONMENT**  
**(Environmental Analytical Chemistry)**  
**CHEM 6284/CHEM 4803**  
**Fall 2014**  
**3 credit hours**

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Since the dawn of history the development of society has been intertwined with quest for sources of energy and power. In the middle of the XX century these two trends have merged into a simple paradigm – conversion of matter to energy. Burning fossil fuels is the chemical process while fission of the nucleus is the physical route. Both have a major impact on environment. As the global population grows, so does the demand for energy. Strictly speaking, the total amount of energy in the Universe is constant and its origin is entirely nuclear. The issue is therefore the energy transformation from one usable form to another and with it the environmental cost of this transformation. The balance between demand for energy and the environmental impact calls for hard choices in social and political sphere. Unfortunately, those choices are often driven by expediency and/or by irrational emotions rather than by the sound scientific principles. Correct decisions cannot be made without understanding the science and engineering behind them. Since the discovery of laws of conversion of mass to energy by nuclear reactions a century ago, intense and often confrontational dialog has developed around the military and the civilian aspects of that conversion. The nuclear science and engineering have played a pivotal role in both. Unfortunately, the impact of nuclear weapons production and testing is being ignored in any discussion of environmental discussion. The nuclear footprint on our society is not a mere historical fact. It is a reality that spans all areas of science and engineering, including physics, chemistry, biology and medicine with all their sub-disciplines. It is a responsibility of living scientists and engineers to understand and deal with the consequences of discovery and practice of nuclear energy conversion.

The aim of this course is to discuss common aspects of nuclear energy, both civilian and military from the scientific perspective and to examine its environmental, health, and socio-economic impact. In order to understand these issues, basics of nuclear physics, chemistry, radiochemistry, environmental transport and biological effects of radiation will be covered in this course. The students will be encouraged to contribute with their opinions and debate the issues using learned scientific principles. Because this is a “current topic”, Internet and daily news will be used heavily in this course.

**Class Hours:** Tuesday, Thursday 9.35-10.55 am; classroom **TBA**  
**Prerequisite:** General Chemistry and General Physics  
**Grading:** Midterm (40%); Class Presentation & Final Essay (30%); Course participation (30%)

**Course Text:** Handouts & Class notes (posted)  
Internet

**Recommended Reading:**

**J. Hala, J.D.Navratil**, “Radioactivity, Ionizing Radiation, and Nuclear Energy”, Konvoj 2003, ISBN 80-7302  
**Karl Heinrich Lieser**, “Nuclear and Radiochemistry”, VCH Publishers, Inc., 1997 ISBN 3-527-29453-8  
**Alan E. Waltar**: "America The Powerless", Cogito Books, 1995; ISBN 0-944838-58-8

## SCHEDULE&OUTLINE

8/19-21	Introduction; course overview; DOE role; Forensics;	
8/26-8/28	non-proliferation and international controls;	
9/2-25	Radiation bootcamp; nucleus stability; chart of nuclides; basics of radiation physics; decay laws; types of radiation; interaction of radiation with matter; measurement of radiation; nuclear reactions;	
9/30	Midterm	
10/2-9	Health effects of ionizing radiation; LNT model; hormesis; acute & chronic radiotoxicity; natural radiation; cosmogenesis & dating	
10/14	Break	
10/16	Timeline; Manhattan project, (movie);	
10/21-30	Reprocessing; military production sites (movie: Hanford today)	
11/4-6	Nuclear Energy production (civilian); Safe reactor designs	
11/1-13	Environmental impact; military releases; industrial accidents; plutonium	
11/18-20	Nuclear waste; disposal options and economics;	
11/25-	Environmental transport; public perception; responsibility of scientists (movie)	
12/2-4	Class presentations	
12/7*	Fat Man & Little Boy (movie optional)	