NUCLEAR TECHNOLOGIES - ISSUES AND CHOICES

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One College Drive Room 204 Kriebel Hall Babson College

Babson Park, MA 02157-0310

Class Schedule: MW 11:30am - 1:05 pm

Office Hours: MW

Course Description:

Examines the history, development, method of operation and future prospects of the important nuclear technologies of our time and the issues they engender. Technologies and issues explored include fission energy production, waste disposal, weapons and their control, fusion technologies, nuclear proliferation, nuclear medicine and the environmental and societal impacts of these nuclear technologies. Throughout the course, the science and technology of nuclear technologies is presented, followed by an analysis of their current and projected future impacts on society. Students should have a basic background in science and will be encouraged to make their own judgments on nuclear technologies based on knowledge, understanding and critical thinking. This seminar course allows ample opportunity for exchange of ideas, and may involve field trips to a nuclear power plant, a nuclear irradiation facility and a nuclear medicine facility of a local hospital.

4 Credits 3 Lecture hours/week (no lab)

Prerequisite: Foundation science course (SCN2110,2120,2130 or 2140) or foundation science waiver or permission of instructor. This course fulfills a category II elective in the Science, Technology and faculty (STS) concentration and an elective in the EPS major..

Required Materials (Available in Bookstore):

(1) Richard Wolfson, "Nuclear Choices - A Citizen's Guide to Nuclear Technology", MIT Press, 1993 (496 pages) ISBN 0-262-73108-8

(2) Readings Packet (page 5)

Attendance : Students are responsible for all material covered and assignments made during class.

Grading:

Lecture: - There are two (2) hour exams and 1 final exam valued at 100 points each. Exams will be held on Wednesday, March 1 and Wednesday, April 12 during scheduled meeting times. Final Exam time - TBA

Project: - The project involves a written exploration, analysis and oral presentation of one of the main course topics. The written projects will be submitted at the time of the class discussion. Students will work in groups of three or four. The project is valued at 100 points - 80 points on the written document and 20 points on the oral presentation. See pages 4 for project details. See page 6 for possible project topics.

Class Participation - This is a seminar course. Class discussion is important and contributes to the development of the understanding and critical thinking about course issues. Class participation, therefore, will contribute 50 points toward the final grade. Class absences will reduce the class participation grade.

Final Grade - The maximum point total for the course is 450 points and final grades are earned as follows:

405 - 450 A {+ and - grades may be assigned within a 360 - 404 B range of +/- 13 points of cutoffs}

315 - 359 C

270 - 314 D

< 269 F

Make-Up Policy: No make-up exams will be given withoutwritten documentation from the Undergraduate Dean's Office.

Homework: Homework problems and exercises will be assigned roughly on a weekly basis. These will be discussed in class.

SELECTED TOPICS IN SCIENCE:

Nuclear Technologies - Issues and Choices

Class Outline:

Spring, 1997

Week Topic Chapter/Readings

1 Course Summary, Atomic structure, radioactivity syllabus, 1,2,3, #1

2 Radiation - background, effects, measurement 3,4 #2

3 Binding energy, fission, fusion 5, #3

4 Energy, power, nuclear reactors 6,7,8 #4

5 Test #1 Wednesday, February 21 1-8, #1-4

6 TMI, Chernobyl - Nuclear Reactor Accidents/Safety 9, #6

7 Nuclear Waste, Hot fusion 10, 11(265-274) #5

8 Nuclear weapons - history, technology, effects 12,13 #7

9 Strategic Nuclear Forces, delivery, treaties 14,15,16 #8

10 Test #2 Wednesday, March 27 10-16, # 5-8

11 Dismantling nuclear weapons - technology, & politics #9

Nuclear Non-proliferation Treaty

DOE Environmental Restoration - weapons testing

12 Food irradiation #10

13 Project presentations (April 15,17,22,24)

14 FINAL EXAM (TBA)

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Research Project

The purpose of the research project is to conduct a detailed investigation of one of the nuclear related topics discussed in the course. The investigation must deal with the science, technology and societal issues raised by the technology. The topic should be developed so as to provide all the information and evidence to allow readers can form their own views and opinions of the technology or issue.

Project topics must be decided upon by February 12th. The project is valued at 100 points. For maximum credit, the project must include the following:

1. Introduction - An overview and description of the project or problem. This section should orient the reader to the following sections.

2. Results of Investigation - This should include the three sections: (a) the science supporting the technology, (b) the technological application and (c) the societal issues raised by the application of the technology.

3. Analysis/Conclusions- Presents your overall analysis and assessment of the problem or project. Any recommendations or opinions of what you have investigated should be included here with supporting documentation.

4. Works Cited - cite works after Turabian, A Manual for Writers: 5/e, University of Chicago Press, 1987. (available on reserve in Horn Bookstore; see chapters 8 & 11 [in Chap. 11 see examples of use of parenthetical in-text reference, PR, and reference (works cited) list, RL].

Research Paper Guidelines:

Length: 5-6 pages per student (double spaced) not including references and exhibits.

References: minimum 10 major references.

Pagination: Pages must be numbered at upper right.

Description: the original printed copy must be submitted (no photocopies)

Papers Due at Time of Presentation

Late topics/papers will result in a grade reduction

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Reading List

1] Mark L. Campbell, "Simple Rules for Determining Nuclear Stability and Types of Nuclear Decay",Journal of Chemical Education, 1995, 72(10), October, 892-893.

2] Len Ackland, "Radiation Risks Revisited", Technology Review, February/March,1993,56-61.

3] Jerry E. Bishop, "Cold Fusion", Popular Science, August, 1993,47-51 & 82.

4] Dawn Stover, "The Nuclear Legacy", Popular Science, 1995, August, 52-58 & 81-83.

5] Luther J. Carter, "Ending the Gridlock on Nuclear Waste Storage", Issues in Science and Technology, Fall, 1993,73-79.

6] Michael Cross, "Nuclear Power on Britain's Back Burner", New Scientist, 6 November 1993, 34-39.

7] Kevin Cameron, "Taking Apart the Bomb", Popular Science, April, 1993,64-69 & 102-103

8] Michael May, "Nuclear Weapons Supply and Demand", American Scientist, November-December,1994, 82, 526-537.

9] Mark Hibbs, "Plutonium, politics, and panic", The Bulletin of Atomic Scientists,November/December, 1994, 24-31.

10] Judith Anne Gunther, "The Food Zappers", Popular Science, January, 1994,72-77 & 86.

Possible Project Topics:

1 The smuggling of fissile materials from the former USSR - Fake or Factual?

3. Spent Nuclear Fuel Reprocessing - current status and future prospects

4. Analysis of US PWR nuclear reactors versus the Canadian CANDU reactors

5. Dismantling Nuclear Weapons - Storage and Disposal of the Nuclear Material - Here and Abroad.

6. The Nuclear Non-Proliferation Treaty (NPT)- history, reratification and future promise. (Originally written in 1968 the treaty was indefinitely reauthorized in April, 1995.

7. Health effects of low level long term exposure to nuclear radiation

8. Breeder Reactors - technology, current status and future potential (Recently France, Japan and India have increased activity with this reactor. At the same time the US has scrubbed it)

9. Radiation in cancer treatment - Boron neutron capture therapy (BNCT) Science, 23 Sept, 1994 p 1799. First use in Boston, 1994.

10. Food irradiation - safety and future. One of largest irradiation facilities in Northboro, MA. - Isomedix

11. Radon - the reality and the myth (A recent study from Britain suggests the threat from radon has been greatly exaggerated)

12. Chernobyl: An analysis of the accident nine years later. A 60 minutes documentary in December, 1994 showed that Chernobyl is vulnerable to a worse disaster and a Day One documentary in the same month suggested that the other former Soviet reactors are in similar conditions.