ENU 5186 - Nuclear Fuel Cycle (3 Credits) - Elective Course, Fall 2005

Course Description: Review the Nuclear fuel cycle from uranium mining, conversion, enrichment, and fuel processing and fabrication through fuel operation, and reprocessing, recycling and waste disposal. Study the commercial reactor fuel cycle including economics, advanced fuel management techniques, assembly and core evaluations of reactivity, power peaking, use of burnable poisons, and control rods and other control schemes and recycling of mixed oxide fuels. The major factors affecting the fuel cycle operations such as fuel power peaking, control worth, and fuel failure mechanisms will be covered. The Turkey Point, Crystal River and Hatch Reactor reload submittals will be evaluated as examples of reload fuel management.

Prerequisites: the basics of nuclear reactors, nuclear fuel design and nuclear reactor theory.

Course Objective: This course is intended to give students an understanding of nuclear fuel cycle issues that affect the performance and economics of nuclear energy. This course describes each of the processes to produce, utilize and dispose of nuclear fuel.

Computer calculations are performed to determine enrichment and total fuel batch sizes to achieve a target amount of energy production for a year. Students will develop the competence to make independent judgment on these matters.

ABET Program Educational Objectives / Professional Components Supported by Course:

1. Graduates will have successful careers in Nuclear Engineering and related disciplines.
2. Graduates will pursue advanced degrees or continuing education.
4. Graduates will use the knowledge and skills obtained in their undergraduate education to practice high ethical and professional standards in Nuclear Engineering and related disciplines

Program Outcomes Supported by Course:

Outcome a: An ability to apply knowledge of mathematics, science, and engineering for problem solving in engineering.
Outcome e: An ability to identify, formulate, and solve engineering problems.
Outcome h: The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and societal context.
Outcome i: A recognition of the need for life-long learning and the ability to adapt this to engineering practice.
Outcome j: A knowledge of contemporary issues as they relate to professional engineering practice.
Outcome k: An ability to use the techniques, skills, and modern engineering tools, including modern computational skills and tools, necessary for nuclear and radiological engineering practice.
Outcome l: An ability to apply advanced mathematics, science, atomic and nuclear physics and engineering to nuclear and radiological systems and processes.
Outcome n: An ability to work professionally in one or more areas of: nuclear power reactors, nuclear instrumentation and measurement, radiation protection and shielding, and radiation sources and applications

Text:

(1) The Nuclear Fuel Cycle: Analysis and Management, 2nd Edition, Robert Cochran and Nicholas Tsoulfamides, American Nuclear Society, 1999.
(2) Collected papers from various sources to be handed out in Class.

Grade Determination:

Homework and class attendance	15%
Quizzes	20%
Fuel Reload Project Report	20%
Midterm Exam	20%
End of Term Exam	25%

Course Outline (classes are approximate)

1. The fuel cycle and its processes and scheduling (2 classes)
2. Fuel cycle economics and computer codes (7 classes
3. Uranium exploration, mining and milling and conversion (2 classes)
4. Uranium Enrichment (2 classes)
5. Fuel Design, Processing, and Fabrication (3 classes)
6. In-core fuel management, Out-In Fuel cycle, including the linear theory of reactivity for easy Fuel cycle/fuel Management calculations (8 classes)
7. Licensing of nuclear fuel/cores by the NRC (3 Classes)
8. Scooping calculations for fuel handling utilizing CASMO/EASCYC (8 classes)
9. Plutonium recycle (2 classes)
10. Fuel reprocessing, spent fuel handling and waste disposal (4 classes)

Instructor - Professor James Tulenko

Alternate Instructor - Dr. Robert Smith