ENU 4192 - Nuclear & Radiological Engineering Design 1 (4 cr), Required Course, Spring, 2006

Course Description: Nuclear reactor theory and engineering as applied to design synthesis of reactors. Nuclear, material, thermo-fluid, and/or mechanical design considerations of nuclear reactors with particular emphasis on design characteristics. Analytical methods and application of computer codes for design analysis and evaluation. Individual and/or group design involving integration of reactor neutronics, dynamics and control, thermal hydraulics, transient analysis and safety, power production, instrumentation, control, radiation shielding and protection, fuel cycle, fuel behavior and cost.

The course emphasizes engineering design team building, group collaboration, leadership, and professional and technical qualities that are needed to succeed in the highly demanding nuclear industry environment. Performing in a collaborative team environment, meeting deadlines, preparing a high quality report, making effective presentations, and group member evaluation are strongly emphasized.

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.
3. Graduates will communicate effectively and work collaboratively in Nuclear Engineering and related disciplines.
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 c: An ability to develop an engineering design to meet specific technical requirements within realistic constraints such as economic, environmental, health and safety and reliability.
Outcome d: An ability to function on multi-disciplinary skills teams.
Outcome e: An ability to identify, formulate, and solve engineering problems.
Outcome f: An understanding of professional, ethical and regulatory responsibility in engineering practice.
Outcome g: An ability to communicate effectively, using both oral and written presentations, in engineering practice.
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: Instructor's Notes and Handouts

References: See Class Handout

Example Computer Codes: See Class Handout

Grading: Grades are based on performance achieved in accomplishing the following deliverables:

QTY	Assignment	Grade
1	Initial Design Proposal Report	15%
1	Initial Design Proposal Presentation	5%
6	Memos (via email)	10%
6	Bi-Weekly Progress Reports (BWPR) (presented up to 10 min by a group member)	30%
1	Final Design Analysis Report (with details of each Design Analysis topic)	25%
1	Final Design Analysis Presentation	15%
Total		100%

Report Content:
Reports should address researchers involved, group, reporting period, technical progress and description of activities conducted in reporting period by task, progress/deliverables required by the reporting period, and other relevant information.

Design Goals (listed): 20 MW_{th} Liquid-cooled research reactor; select fuel material and fuel design to include viable fuel life cycle and system that is proliferation resistant.

Experimental Cavities/Facilities [in-core cavity to include ability to test GEN4 samples of interest]

In Core	Ex Core
Liquid/Gas Cooled	Neutron cavities{fast, epithermal, thermal, cold} minimized gamma fluence
Peak Temp must be 800C	Gamma with minimized neutron fluence
Peak flux must be 10^{15}	Beam port capable, integrated with shielding

Literature Review: World-wide design review (all major designs) and Recent Designs (within past 5 years)

Proposal (Each group submits): must demonstrate ability to achieve design goals

Proposals will be evaluated for a grade; a final design will be selected

Design Analysis (Group # responsible (out of 3))

Group	Topic	PPR:
Group 1	Reactor Physics	(GS)
Group 2	Thermal hydraulics	(ED, AH, GS)
Group 1	Reactivity Control	(ED)
Group 3	Instrumentation	(JB, AH, ED)
Group 3	Shielding and radiation protection	(AH)
Group 2	Fuel cycle length estimate	(GS, ED)
Group 1, 2 & 3	Cost estimate	(GS)

Professor of Primary Responsibility (PPR):
*JB= Prof. James Baciak, ED=Prof. Edward Dugan, AH=Prof. Alireza Haghighat, GS=Prof. Glenn Sjoden

Prepared by Profs. James Baciak, Edward Dugan, Alireza Haghighat, and Glenn Sjoden Spring, 2006