Department of Nuclear Engineering
University of California
Berkeley, CA 94720-1730

NE-170 Nuclear Design (3 Units)

Catalog Description

Design analysis of fusion nuclear power systems; economics of nuclear power plants; construction, performance, fuel cycles and decommissioning; elements of probabilistic risk assessment applied to nuclear reactors.

Course Prerequisite(s)

- NE161 or instructor's consent

Prerequisite knowledge and/or skills

NE 170 is a "capstone" design course requiring students to integrate the knowledge obtained in their undergraduate courses into a comprehensive design experience. This course is best taken after completing the remaining undergraduate Nuclear Engineering requirements.

Textbook(s) and/or other required material

None.

Undergraduate textbooks from other NE courses should be the first source of references.

Course objectives and outcomes

NE 170 is markedly different from other undergraduate courses in that the instructor acts more as a coach than a teacher. Sketching some broad design parameters of a system, the instructor shepherds the students through a comprehensive design experience. Students must take charge of their own learning, using the instructor as a consultant and resource to point them in the right direction when they "get stuck." It is the instructor's objective to create an environment in which students can both meet design requirements and gain confidence in their abilities to solve large, complex, open-ended projects.

Course Outcomes: Students must be able to...

(Concept development)

- Make a written proposal for the project.
    - Set up a design goal.
    - Identify design parameters of the system and sketch the performance of the proposed system.
- Establish quantitative models that show the performance of the system, by taking charge of their own learning, and analyze the system performance quantitatively.

(Feedback and Improvement)

- Modify the preliminary design based on the outcome of the model analysis.

(Demonstration, Presentation and Reporting)

- Make a prototype of the system to demonstrate that the design is feasible.
- Prepare a written final design report and oral presentation of the report.

Topics covered

Actual nuclear system design involving:

- Nuclear power system: core physics (criticality, reactivity, enrichment, burn-up, fission-product formation), thermal hydraulics (heat transfer, heat exchange, thermal efficiency), materials (corrosion), safety (temperature and void coefficients, emergency cooling), shielding.
- Nuclear fuel cycle system: chemistry (separation efficiency, waste generation), safety (criticality, radiation shielding, hazardous materials)
- Radioactive waste management: safety (radiological, criticality), waste treatment (solidification, transportation), waste disposal (geologic repository)

Class/laboratory schedule

Students perform their design project by a team. They meet at least once per week with faculty supervisor to give a progress report, obtain advice and discuss design issues.

Contribution of course to meeting the professional component

This course contributes primarily to the students' knowledge of engineering topics, and does provide design experience.

Since NE170 is a comprehensive design project focusing on nuclear systems, it implicitly contains elements of economic, environmental, ethical, health and safety, manufacturability, sustainability considerations. Some projects could contain elements of political and societal considerations.

Relationship of course to undergraduate degree program objectives

This course primarily serves students in the department. The information below describes how the course contributes to the undergraduate program objectives.

NE170 encompasses most of the NE program's educational objectives, including emphasis on design methodology, working in teams, and preparing comprehensive written and oral presentations.

Assessment of student progress toward course objectives

- Student's ability to work with other team members, participating but not dominating the group, working constructively with others.
- Planning, establishing, and developing a concept into a realistic design.
- Written final design report (typically 50-100 pages in length, addressing as many issues as possible)
- Oral presentation of report: each member gives a 15-20 minute presentation of some part of the report, followed by a questioning by the instructor to explore topics the student didn't cover as well as general knowledge expected of a student completing the program
- Written Proposal (within the first 3 weeks) 25%
- Bi-weekly report to the instructor: 25%
- Written Final Report: 30%
- Oral Presentation: 20%

Person who prepared this description

J. Ahn