

**NUCL 450 Design in Nuclear Engineering
Spring 2018**

8 January 2018

Course Description: Prerequisite: NUCL 449. Application of the design process to the design of various reactor engineering components and systems. Mathematical modeling in design, neutronics, economics, fuel, thermal, fluid, materials, and safety problems are considered. [Computer Usage: Extensive use of programs for analysis. Students are expected to have acquired neutronics and thermal hydraulics analysis codes from RSICC from NUCL 449]

Goals: By the synthesis of materials learned in other courses and appropriate analyses, to provide the student with a directed design experience to train him/her to meet professional responsibilities that he/she will encounter as a practicing engineer.

Topics: Engineering design fundamentals and code familiarization (2 wks), Systems engineering (1 wk), Nuclear power economics (1 wk), Analysis methods (1 wk), Core design (1 wk), Optimization (1 wk), Safety requirements (1 wk), Codes and standards (1 wk), Event and fault tree analysis (1 wk)

Textbooks: Alexander Sesonske, *Nuclear Power Plant Design Analysis*, United States Atomic Energy Commission, Tennessee (1973). ISBN 0-87079-009-9 [Recom]. S. Glasstone and A. Sesonske, *Nuclear Reactor Engineering*, Vol. I (Reactor Design Basics), 4th Ed., Chapman & Hall (1994). ISBN: 0-412-98521-7 [Recom]. Barry Hyman, *Fundamentals of Engineering Design*, 2nd Ed., Prentice Hall, New Jersey (2003). ISBN 0-13-046712-X [Required]. Y. Oka (Ed.), *Nuclear Reactor Design*, Springer (2014). ISBN: 978-4-431-54897-3. [Free to Purdue students via www.link.springer.com → MyCopy].

Instructors: Profs. C. K. Choi, choi@purdue.edu, & M. Bertodano, bertodan@purdue.edu
Office Hours: MWF 2:30 – 3:20 PM @NUCL 112B (CKC) and
MW 10:30 AM – 12:30 PM @NUCL 112D (MB)

Course Grading: **Project Plan** report and presentation, homework, quizzes, and weekly progress reports (30%); two monthly **Design Review** presentations, and the **Final Report** and presentation (60%); attendance and class participation (10% - max. 2 abs. allowed; 5% for 3 abs.; and 0% for 4 abs.) [10-min. inactivity in class is same as being absent, i.e., not-in-class, usage of electronic devices for emails, gaming, etc.]
 $85\% \leq A \leq 100\%$, $70\% \leq B < 85\%$, $55\% \leq C < 70\%$, $40\% \leq D < 55\%$, and not passing below 40%. Absence from any project presentations (Project Plan, Design Reviews, and the Final Presentation) will result in lowering one grade.

The Accreditation Board for Engineering and Technology (ABET) Definition of Design:

Engineering Process of devising a system, component, or process (i.e., design product) to meet desired needs by establishing objectives and criteria, synthesis, analysis, construction, testing, and evaluation. It is essential to include a variety of realistic constraints, such as economic factors, safety, reliability, aesthetics, ethics, and social impact.

Emergency Preparedness –A Message from Purdue:

To report an emergency, **call 911**. To obtain updates regarding an ongoing emergency, sign up for Purdue Alert text messages, www.purdue.edu/ea.

There are nearly 300 **Emergency Telephones** outdoors across campus and in parking garages that connect directly to the PUPD. If you feel threatened or need help, push the button and you will be connected immediately.

If you hear a **fire alarm** during class, we will immediately suspend the class, evacuate the building, and proceed outdoors. Do not use the elevator.

If we are notified during class of a **Shelter in Place requirement for a tornado** warning, we will suspend the class and shelter in [the basement].

If we are notified during class of a **Shelter in Place requirement for a hazardous materials release, or a civil disturbance**, including a shooting or other use of weapons, we will suspend the class and shelter in the classroom, shutting the door and turning off the lights.

Please review the Emergency Preparedness website for additional information. http://www.purdue.edu/epps/emergency_preparedness/index.html.

Campus Emergency: In the event of a major campus emergency, course requirements, deadlines, and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances. Information about the changes in this course in such emergencies would be obtainable from the course instructor and/or the university provost office.

Academic Integrity is one of the highest values that Purdue University holds and the University prohibits “dishonesty in connection with any University activity. Cheating, plagiarism, or knowingly furnishing false information to the University are examples of dishonesty.” Individuals are encouraged to alert university officials to potential breaches of this value by either emailing integrity@purdue.edu or by calling 765-494-8778. While information may be submitted anonymously, the more information that is submitted provides the greatest opportunity for the university to investigate the concern.

Purdue Honors Pledge:

“As a boilermaker pursuing academic excellence, I pledge to be honest and true in all that I do. Accountable together – we are Purdue.”

<Purdue’s Honor Pledge>

POLICIES AND PROCEDURES FOR SENIOR DESIGN PROJECTS:

Teams: Teams will be formed to exercise team building skills, conduct senior projects under NUCL 450, work classroom exercises (such as formal design reviews), and prepare and present the project report. Maximum members/team: six.

Exams: There will be neither formal examinations nor a final examination in the course. However, **10-minute quizzes** will be given periodically. These will be "open note" and will generally cover subject material from the previous three topics/lectures.

Project Plan: Each team will prepare the Project Plan Report according to the following outline: The Report should not exceed **5 pages** (one-sided), **single-spaced, 12-point**, excluding a title page, approval page, references and appendices. The oral presentation will be scheduled for **15 minutes** per team, exclusive of discussions.

Title Page: Identify Project Plan Report, project title, member names and the dates.

Executive Summary/Abstract: Give succinctly in one or two paragraphs on a separate page, an abbreviated statement of the background, the objectives of the project, the approach intended, the resources and the time required.

Introduction: What does the reader need to know to understand the project? What is the background leading to the project? Why is the project being done and what is being attempted? How is it done today? If the approach is different, why is it different (or unique)? If the project is successful, what will be the significance?

Goals and Objectives: Describe in 2 to 4 lines each the principal goals and objectives.

Approach: Describe how the team intends to carry out the project taking into account the following factors, as appropriate:

- work elements (major subtasks) [**identify the contributing member(s)**]
- analytic methods/computational tools and codes identified
- facilities, equipment required (if appropriate), and industry collaboration
- project organization (**Who is assigned what? – Please be very specific.**)
- project schedule (Gantt charts, milestones, completion dates for each)
- economic analysis including the cost optimization (as appropriate)
- assumptions, limitations, engineering constraints, safety, & social impacts
- discussion (discuss how the approach and methods of analysis will successfully achieve the objectives including safety and social impacts)
- approval page (include the signatures from all faculty advisors involved)
- references (cf. web site citations are not regarded as peer reviewed)
- appendices

Weekly progress reports: Two weekly progress reports will be submitted **individually** during the semester to confirm the status of the project. The purpose of these reports is to help the team learn to monitor the progress and maintain their Gantt schedule.

Project Design Reviews: Two formal design reviews will be conducted by each team during the semester. Approximately **15 minutes** for each presentation per team are scheduled, exclusive of discussion (Note: Each 15-min. presentation is graded **individually**); hard copies of the viewgraphs and the accompanying written reports are required.

The following topics will be included in the **Design Review** presentations:

- Project title, scope and objectives** (any changes from the plan?)
- Design requirements established** (how prioritized?)
- Progress for meeting requirements** (include summary of analysis as time permits)
- Issues** (scope, technical, schedule, resources, other?)
- Planned actions to achieve closure on the issues**

A team member will be designated as a spokesperson for the review. He/she will be responsible for establishing a formal log of all issues, action items, and persons responsible for the action items identified in the review. The designated team spokesperson for the review will be responsible for notifying the faculty advisor when issues and the actions identified in the review are either accomplished or otherwise closed.

Final Project Report: The Final Report will conform generally to the outline for the Project Plan, except the following sections will be added after the **Approach**. The length and amount of detail will be limited to **20 pages** in length (one-sided), **double column, 1.5-spaced, 12- point**, exclusive of the title page, approval page, references and appendices.

Design and Discussion: Discuss the nature of your design and the results of your design analysis including engineering constraints, economic factors, safety, and social and environmental impacts. Details of the design analysis (numerical tables, mathematics, detailed drawings, and description of standard or procedures) should be placed in the appendices and referenced in the text.

Conclusions and Recommendations: What are the principal findings with regard to the project goals/objectives and design requirements? What unresolved issues have been uncovered with respect to technical performance, practicality, reliability, cost, safety, license and training requirements, utilization, or other? What are the specific recommendations with regard to further design effort or design implementation?

Oral Presentations: All oral presentations will involve all team members both during the presentation and the question period. Presentation times will be as follows (exclusive of Q & A):

- Project Plan:** **15 minutes** (Performance Individually evaluated)
- Design Reviews:** **15 minutes** (Performance Individually evaluated)
- Final Project Presentation:** **30 minutes** (Performance Individually evaluated)

Grading of each presentation will be based on the following:

- Substance** (covers the key technical elements with goals achieved) 40%
- Credibility** (key findings supported by credible analysis and industry) 10%
- Originality** (completed designs not duplicate of others) 10%
- Presentation** (interesting and presented professionally in time limit) 20%
- Visuals** (clear, readable, and logically organized) 10%
- Teamwork** (clear evidence of teamwork by all members) 10%

NUCL 450 Spring 2018: Schedules and Activity Dates

- I. Project Plan - Report (5 pages per Team) and Presentation (15 min. per Team):**
**** Performance evaluated individually ****

Jan. 19 (F), 2018 - FAST/SIMPLER/HYPER Teams
[Time: 9:30 – 10:20 AM in GRIS 134]

- II. Design Review I – Report (10 pages/Team) and Presentation (15 min./ Team):**
**** Performance evaluated individually ****

Feb. 16 (F), 2018 – SIMPLER/HYPER/FAST Teams
[Time: 9: 30 – 10:20 AM in GRIS 134]

- III. Design Review II – Report (15 pages/Team) and Presentation (15 min. /Team):**
**** Performance evaluated individually ****

Mar. 23 (F), 2018 – HYPER/FAST/SIMPLER Teams
[Time: 9:30 – 10:20 AM in GRIS 134]

- IV. Project Final Draft Report (20 pages/Team) – Due April 16 (M), 2018**

- V. Final Project Presentation (30 min. per Team):**
**** Performance evaluated individually ****

Apr. 24 (Tu), 2018 - FAST/SIMPLER/HYPER Teams
[Time: 3:00 – 5:00 PM(?) in WALC Room (?)]

**Note: The Viewgraphs are due on Mon, Apr. 23, 2018, and
the Final Design Report is due on Mon, Apr. 30, 2018.**

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- VI. Homework and Quizzes: Cover materials from the previous three lectures**

- VII. Weekly Progress Reports (individually submitted) due on Monday: Weekly
progress reports are due on 2/5/18 and 3/5/18.**

Jan. 8, 2018