Course description

This course provides an introduction to the field of nuclear criticality safety. Topics covered include:
- a review of basic concepts related to criticality (fission, cross sections, multiplication factor, etc.);
- criticality safety accidents;
- standards applicable to criticality safety;
- hand calculations and Monte Carlo methods used in criticality safety analysis;
- criticality safety evaluation documents.

Objectives

The objective of this course is to acquaint Nuclear Engineering students with the concepts and practice of nuclear criticality safety, and to help prepare them for a future career in this field.

Outcomes

At the end of this course, students should be able to:

- Explain and define criticality safety factors for operations.
- Discuss previous criticality accidents and their causal factors, including parameters involved in solution and metal critical accidents.
- Identify and discuss the application of several common hand calculation methods.
- Describe the importance of validation of computer codes and how it is accomplished.
- Discuss ANSI/ANS criticality safety regulations.
- Describe DOE regulations and practices in the nuclear criticality safety field.
- Complete a Criticality Safety Evaluation.

Instructor

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4111 Etcheverry Hall
Office hours TBD
TEXTBOOK

Additional references:

PREREQUISITES
NE 150 or consent of instructor.
The course uses the following knowledge and skills from prerequisite and lower-division courses:
- Neutron interactions, cross sections;
- Multiplication factor, reactivity;
- Neutron flux, current;
- Solution of linear, first and second order differential equations;
- Vector calculus, special functions (Bessel functions, exponential integrals).

COURSE STRUCTURE
The course consists of three hours of lecture per week. Some lectures will be delivered by criticality safety experts from a national laboratory.

GRADING
In order to successfully complete the course, students are required to complete:
- a weekly reading assignment;
- a weekly homework;
- a midterm (around week 8);
- a final project consisting in performing a criticality evaluation and compiling a criticality safety evaluation document.

The final grade will be calculated as follows:
- Homework: 30% (lowest grade dropped)
- Midterm: 40%
- Criticality safety evaluation: 30%
Grading scale (tentative): A+ >95%, A >91%, A- >87%, B+ >83%, B >79%, B- >75%, C+ >71%, C >67%, D >59%, F ≤59%

**Academic Integrity**

The student community at UC Berkeley has adopted the following Honor Code: “As a member of the UC Berkeley community, I act with honesty, integrity, and respect for others.” The hope and expectation is that you will adhere to this code.

**Collaboration and Independence:** Reviewing lecture and reading materials and studying for exams can be enjoyable and enriching things to do with fellow students. This is recommended. However, unless otherwise instructed, homework assignments are to be completed independently and materials submitted as homework should be the result of one’s own independent work.

**Cheating:** A good lifetime strategy is always to act in such a way that no one would ever imagine that you would even consider cheating. Anyone caught cheating on a quiz or exam in this course will receive a failing grade in the course and will also be reported to the University Center for Student Conduct. In order to guarantee that you are not suspected of cheating, please keep your eyes on your own materials and do not converse with others during the quizzes and exams.

**Plagiarism:** To copy text or ideas from another source without appropriate reference is plagiarism and will result in a failing grade for your assignment and usually further disciplinary action. For additional information on plagiarism and how to avoid it, see, for example:

http://www.lib.berkeley.edu/instruct/guides/citations.html#Plagiarism
http://gsi.berkeley.edu/teachingguide/misconduct/prevent-plag.html

**Academic Integrity and Ethics:** Cheating on exams and plagiarism are two common examples of dishonest, unethical behavior. Honesty and integrity are of great importance in all facets of life. They help to build a sense of self-confidence, and are key to building trust within relationships, whether personal or professional. There is no tolerance for dishonesty in the academic world, for it undermines what we are dedicated to doing – furthering knowledge for the benefit of humanity. Your experience as a student at UC Berkeley is hopefully fueled by passion for learning and replete with fulfilling activities. And we also appreciate that being a student can be stressful. There may be times when there is temptation to engage in some kind of cheating in order to improve a grade or otherwise advance your career. This could be as blatant as having someone else sit for you in an exam, or submitting a written assignment that has been copied from another source. And it could be as subtle as glancing at a fellow student’s exam when you are unsure of an answer to a question and are looking for some confirmation. One might do any of these things and potentially not get caught. However, if you cheat, no matter how much you may have learned in this class, you have failed to learn perhaps the most important lesson of all.

**Accessibility**

Please see me as soon as possible if you need particular accommodations, and we will work out the necessary arrangements.
## Schedule

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<tr>
<th>Week</th>
<th>Topic</th>
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<tbody>
<tr>
<td>1</td>
<td>Intro; review of neutron interactions, multiplication factor, reactivity</td>
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<tr>
<td>2</td>
<td>Factors in criticality safety: MAGICMERV/MERMAIDS</td>
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<td>3</td>
<td>Criticality accidents</td>
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<td>4</td>
<td>Criticality experiments</td>
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<td>5</td>
<td>Criticality safety evaluation documents</td>
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<td>6</td>
<td>Hand calculations: One-group and modified one-group diffusion theory</td>
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<td>7</td>
<td>Hand calculations: methods review</td>
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<td>8</td>
<td>Monte Carlo code: Intro</td>
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<td>9</td>
<td>Monte Carlo code: Advanced features</td>
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<td>10</td>
<td>Monte Carlo code: Validation</td>
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<td>11</td>
<td>ANSI/ANS Standards (SD130)</td>
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<td>12</td>
<td>DOE 10 CFR 820 and 420.1C</td>
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<tr>
<td>13</td>
<td>Criticality Safety at national labs</td>
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<td>14</td>
<td>Criticality safety evaluation presentation</td>
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