

## UN 0803 Nuclear Reactor Safety Design

### **Instructor:**

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### **Course Description:**

This course covers safety design and analysis of nuclear reactors based on deterministic and probabilistic assessments. Topics include: nuclear safety principles, concepts of risk; probability tools and techniques; safety criteria; design basis accidents and other accidents; risk assessment; deterministic safety analysis; probabilistic safety assessments; regulatory requirements, safety system design; severe accidents; operational safety of reactors; and general policy and principles.

Examples will be drawn from CANDU-6 and multi-unit CANDU designs, with limited discussion of Light Water Reactors (e.g., BWRX-300).

### **Textbook** (essential):

The Essential CANDU textbook - Chapter 13 – UNENE, 2015. <https://unene.ca/education/candu>

### ***Non-Essential References:***

CANTEACH Library Modules 3.7 and 4.3

<https://www.nuceng.ca/canteach-rev2/chulongkorn.html#CHULA-4.4>

REGDOC-2.5.2 (Design), REGDOC-2.4.1 (Deterministic Safety Analysis) and REGDOC-2.4.2 (Probabilistic Safety Assessment). E.g.,

<https://nuclearsafety.gc.ca/eng/acts-and-regulations/regulatory-documents/published/html/regdoc2-5-2-v2/index.cfm>

### **Topics Covered:**

1. Introduction to Nuclear Reactor Safety
2. Design Basis Accidents (and other accidents)
3. Case Studies
4. Safety Strategy, Safety Goals
5. Probability
6. Shutdown Systems (Means of Shutdown)
7. Heat Removal and Containment

8. Deterministic Safety Analysis
9. Safety Analysis Codes
10. Probabilistic Safety Analysis
11. Severe Accidents
12. Operational Reactor Safety

### **Marking:**

In-class participation:	8%
Lecture Attendance:	8%
Homework #1:	8%
Homework #2:	8%
Homework #3:	8%
Project Scope:	5%
Project Method:	5%
Project Report:	10%
Project Presentation:	5%
Final Exam:	25%

### **Final Grades:**

Final grades will be assessed according to the McMaster/UNENE standard grading scheme.

### **Schedule (tentative):**

9 AM – 4 PM Saturdays and Sundays

#### **January 13 - 14**

##### ***Subject***

##### ***Assignment / Project / Presentation***

Section 1 Introduction

Present & discuss possible projects

Section 2 Design Basis Accidents + PIEs ...

Assign Homework 1

Section 3 Part 1 -Experience  
- Reactor Physics Review

Decide on project

#### **February 3 - 4**

Section 3 Part 2 - Experience  
- Case Studies

Submit Project Scope + present informal summary to class

Section 4 Safety Goals and Risk Assessment

Assign Homework 2

Regulatory Framework

#### **February 24 - 25**

Dr. Yüksel Parlatan

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4 January 2024

Section 5 Mitigating Systems – Safety Design

Submit Project Methodology and Model + present informal summary to class

Section 6 Deterministic Safety Analysis – Accident Phenomenology

Assign Homework 3

**March 16 - 17**

Section 7 Deterministic Safety Analysis – Mathematical Models

Submit Final Project Report  
Formal presentation to class

Severe Accident Analysis

Section 8 Operational Safety

March 23 Final Exam