MAAE 4906E: Nuclear Engineering
Winter 2017
Course Outline

Introduction
Over half of the electricity in Ontario is provided by nuclear reactors. The Canadian nuclear industry is comprised of 3 major electricity producers with over $4 billion in electricity sales, a national laboratory in Chalk River, and more that 150 private companies employing more than 32 000 people. Canadian technology is based on the home-grown CANDU heavy water reactor. CANDU reactors have been operating in Canada since 1962, and abroad since 1972. Canada is a major player in sales of reactors worldwide. There are 48 heavy-water moderated reactors based on the CANDU design in operation, under construction, or under refurbishment worldwide.

In addition, Canadians were pioneers in nuclear medicine starting with cobalt-60 irradiation treatment of cancers in the 1960's, and later with the host of medical diagnostic procedures that include ^{99m}Tc imaging of heart and bone diseases. The NRU reactor at Chalk River is the source for approximately 33% of the world supply of ^{99m}Tc, which is used in approximately 80% of the 46 million nuclear medicine tests performed every year worldwide, of which 2 million are performed in Canada.

This course provides an overview of nuclear engineering concepts and practices used to generate electricity and to make nuclear medicine possible. The course will include basic fundamentals, as well as lectures on specific topics. Students with an enthusiasm for basic physics, chemistry and biology, and a good understanding of ordinary differential equations and their solutions, will benefit most from the material presented.

Instructor:
Dr. Christopher Cole
Christopher.Cole3@carleton.ca

Schedule January- April, 2017 Lectures: 3 hours per week. 11:35 – 12:55 Tuesday and Thursday. Mackenzie Building room 3235.

Exams
One mid-term exam will be held on 28 Feb 2017, from 6 pm until 7:30 pm in room 4494 ME and 3328 ME. The final exam will be scheduled by the university during the final exam period. Both the mid-term and final will be closed book examinations comprised of hand-written essay and analytical (number) questions.

Marking Scheme
The final course grade will be determined according to the following:

Mid-term	40%
Final exam	60%

A passing mark (50% and higher) is required on the final exam to pass the course. According to the policy of the Faculty of Engineering and Design, the final examination is for evaluation purposes only and the marked final examination papers will not be returned to the students.

Course outline

The current plan is for the following topics to be presented over 13 weeks by Dr. Cole and potentially guest appearances from Dr. McRae and other experts in nuclear technology. Topic dates may change if required.

Weeks	Date	Topics
1	Jan 5	General Introduction and Overview of the course
2	Jan 10 & 12	Nuclear Physics Fundamentals Radioactivity Photoelectric effect
3	Jan 17 & 19	Mass defect and Binding Energy Chart of the Nuclides
4	Jan 24 & 26	Neutron Diffusion and Moderation
5	Jan 31	Nuclear Reactor Theory
5	Feb 2	Reactor Kinetics (Time dependent reactor)
6	Feb 7 & 9	Reactor Control, Reactor Coefficients
7	Feb 14 & 16	NRU and Chalk River Laboratories
	Feb 21 & 23	**READING WEEK – NO CLASSES**
8	Feb 28	**MIDTERM 6 PM Canal Building 2104 & 2202**
8	Mar 2	Commercial Reactors, PWR & BWR
9	Mar 7 & 9	Reactor Poisoning, Xenon oscillations Fuel and Fuel Cycle
10	Mar 14 & 16	Radiation Protection
11	Mar 21 & 23	Reactor Materials and Corrosion
12	Mar 28 & 29	Reactor Safety
13	Apr 04 & 06	Nuclear Medicine Applications and final review

Textbook and Reference Material

There is no required textbook for the course due to the vast range of topics covered. However, there is a free textbook entitled "The Essential CANDU" published by the Canadian Nuclear Society which can be found at the following link: www.nuceng.ca/candu

Another valuable textbook is "Introduction to Nuclear Engineering" 3rd Edition by John L. Lamarsh. This is a good reference source if you wish to continue your studies in nuclear engineering.

Academic Accommodation
You may need special arrangements to meet your academic obligations during the term. For an accommodation request the processes are as follows: Reactor Poisoning, Xenon oscillations

Pregnancy obligation: write to me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details see the Student Guide

Religious obligation: write to me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details see the Student Guide

Academic Accommodations for Students with Disabilities: The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or pmc@carleton.ca for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send me your Letter of Accommodation at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). After requesting accommodation from PMC, meet with me to ensure accommodation arrangements are made. Please consult the PMC website for the deadline to request accommodations for the formally-scheduled exam (if applicable).