Engineering Physics
ENG PHYS 784
Nuclear Fuel Management in-Core
Graduate Studies
Fall 2025
Course Outline

INSTRUCTOR OFFICE HOURS AND CONTACT INFORMATION

Dr. Benjamin Rouben
NRB-B121
roubenb@mcmaster.ca

Office Hours:
By appointment, or by e-mail or zoom any time

COURSE WEBSITE/ALTERNATE METHODS OF COMMUNICATION

The official means of communication with students is via the course webpage on Avenue to Learn.
It is the students' responsibility to regularly check the course webpage for updates and announcements.
Avenue to Learn is the official course website for course communication, submission of work and grading. The Avenue to Learn course webpage will have all components of the course. However, when e-mailing the instructor, please send communications to roubenb@mcmaster.ca.

CLASS FORMAT

Course Dates: 2025 September 4 to December 4
Units: 3
Course Delivery Mode: All classes are in-person
Course Description:
This is a course on in-core fuel management in nuclear reactors. It covers all aspects of the use of nuclear fuel in CANDU reactors, with comparison to fuel management in light-water reactors. The course includes full-core calculations in simplified but realistic CANDU models. This requires analysis by computer codes and presentation of project results orally and by computer.

The course is scheduled as follows:

- C01: lecture Thursday 10:30 am – 1:30 pm

Lectures will not be recorded.

While it is not a formal prerequisite, having previously followed a course on Reactor Physics is very much recommended.

Absenteeism policy: A missed lecture does not cancel the need to submit assignments by the due date..

COURSE INTENDED LEARNING OUTCOMES

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

- Understand and explain the different levels of CANDU-6 reactor-physics models

- Be able to run the provided reactor physics computer codes, analyse and report the results of flux, power, fuel in-core residence time, and attainable fuel burnup, and report the results in class
- Perform a computer "core-follow" of a CANDU-6 reactor for at least 30 Full Power Days of operation, analyse and report and present the results in class.

COURSE SCHEDULE

Date/Week	Topic	Readings
Weeks 1-2	Front end of nuclear cycle. Review of nuclear-fuel cross sections. Fluence, burnup. Uranium enrichment, effect on resource utilisation.	
Weeks 3-4	Reactivity curve of fuel. Estimating the fuel exit burnup. CANDU lattice calculations with DRAGON code.	
Weeks 5-6	Flux/power flattening. The CANDU Equilibrium Core and Time-Average Model. The DIFC6G full-core diffusion code.	
Weeks 7-8	Students' individual presentations of their Project 1.Channel ages. Snapshot models based on time-average case.	
Weeks 9-10	The CANDU core-follow. Criteria for selecting channels for refuelling.	
Week 11	PWR fuel management	
Week 12	Students' individual presentations of their Project 2. Short Final Quiz.	

This lecture schedule is based upon current university and public health guidelines and may be subject to changes during the term. Any changes to the schedule or course delivery will be communicated on the course announcements section on Avenue to Learn. Please check the announcements prior to attending class.

REQUIRED/OPTIONAL MATERIALS AND FEES

Required Texts:
Instructor's Learning Modules on Avenue to Learn

Recommended Additional Texts (Suggested but not required)
1) The Essential CANDU - a textbook about the CANDU nuclear reactor (chapter 21) (http://www.nuceng.ca/candu/)
2) "The Nuclear Fuel Cycle: Analysis and Management", by Robert G. Cochran & Nicholas Tsoulfanidis, ISBN: 0-89448-451-6

Calculator:
Only the McMaster Standard Calculator will be permitted in tests and examinations. This is available at the Campus Store.

Other Materials:
Software provided by Instructor.

COURSE ASSESSMENT DETAILS

Component	Weight
Assignments	20%
Projects	70%
Final Quiz	10%
Total	100%

GRADING SCALE

Grade	Points	Equivalent Percentages	Pass/Fail
A+	12	90 – 100	P+
A	11	85 – 89	P
A-	10	80 – 84	P
B+	9	77 – 79	P
B	8	73 – 76	P
B-	7	70 – 72	P
F	0	69 and under	F

COURSE POLICY ON MISSED WORK, EXTENSIONS, AND LATE PENALTIES

- Assignments or Projects not submitted by the due date will not receive a mark.

GENERATIVE AI

USE PROHIBITED

Students are not permitted to use generative AI in this course. In alignment with McMaster academic integrity policy, it "shall be an offence knowingly to … submit academic work for assessment that was purchased or acquired from another source". This includes work created by generative AI tools. Also state in the policy is the following, "Contract Cheating is the act of "outsourcing of student work to third parties" (Lancaster & Clarke, 2016, p. 639) with or without payment." Using Generative AI tools is a form of contract cheating. Charges of academic dishonesty will be brought forward to the Office of Academic Integrity.

APPROVED ADVISORY STATEMENTS

EQUITY, DIVERSITY, AND INCLUSION

Every registered student belongs in this course. Diversity of backgrounds and experiences is expected and welcome. You can expect your Instructor to be respectful of this diversity in all aspects of the course, and the same is expected of you.

The Department of Engineering Physics and the Faculty of Engineering are committed to creating an environment in which students of all genders, cultures, ethnicities, races, sexual orientations, abilities, and socioeconomic backgrounds have equal access to education and are welcomed and treated fairly. If you have any concerns regarding inclusion in our Department, in particular if you or one of your peers is experiencing harassment or discrimination, you are encouraged to contact the Chair, Associate Undergraduate Chair, Academic Advisor or to contact the Equity and Inclusion Office.

ACADEMIC INTEGRITY

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity. **It is your responsibility to understand what constitutes academic dishonesty.**

Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university. For information on the various types of academic dishonesty please refer to the *Academic Integrity Policy*, located at https://secretariat.mcmaster.ca/university-policies-procedures-guidelines/

The following illustrates only three forms of academic dishonesty:
1. plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.
2. improper collaboration in group work.
3. copying or using unauthorized aids in tests and examinations.

AUTHENTICITY / PLAGIARISM DETECTION

Some courses may use a web-based service (Turnitin.com) to reveal authenticity and ownership of student submitted work. For courses using such software, students will be expected to submit their work electronically either directly to Turnitin.com or via an online learning platform (e.g. A2L, etc.) using plagiarism detection (a service supported by Turnitin.com) so it can be checked for academic dishonesty.

Students who do not wish their work to be submitted through the plagiarism detection software must inform the Instructor before the assignment is due. No penalty will be assigned to a student who does not submit work to the plagiarism detection software. **All submitted work is subject to normal verification that standards of academic integrity have been upheld** (e.g., on-line search, other software, etc.). For more details about McMaster's use of Turnitin.com please go to www.mcmaster.ca/academicintegrity.

COURSES WITH AN ON-LINE ELEMENT

McMaster is committed to an inclusive and respectful community. These principles and expectations extend to online activities including electronic chat groups, video calls and other learning platforms.

Some courses may use on-line elements (e.g. e-mail, Avenue to Learn (A2L), LearnLink, web pages, capa, Moodle, ThinkingCap, etc.). Students should be aware that, when they access the electronic components of a course using these elements, private information such as first and last names, user names for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in a course that uses on-line elements will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure, please discuss this with the course instructor.

ONLINE PROCTORING

Some courses may use online proctoring software for tests and exams. This software may require students to turn on their video camera, present identification, monitor and record their computer activities, and/or lock/restrict their browser or other applications/software during tests or exams. This software may be required to be installed before the test/exam begins.

CONDUCT EXPECTATIONS

As a McMaster student, you have the right to experience, and the responsibility to demonstrate, respectful and dignified interactions within all of our living, learning and working communities. These expectations are described in

the *Code of Student Rights & Responsibilities* (the "Code"). All students share the responsibility of maintaining a positive environment for the academic and personal growth of all McMaster community members, **whether in person or online**.

It is essential that students be mindful of their interactions online, as the Code remains in effect in virtual learning environments. The Code applies to any interactions that adversely affect, disrupt, or interfere with reasonable participation in University activities. Student disruptions or behaviours that interfere with university functions on online platforms (e.g. use of Avenue 2 Learn, WebEx or Zoom for delivery), will be taken very seriously and will be investigated. Outcomes may include restriction or removal of the involved students' access to these platforms.

Academic Accommodation of Students with Disabilities

Students with disabilities who require academic accommodation must contact Student Accessibility Services (SAS) at 905-525-9140 ext. 28652 or sas@mcmaster.ca to make arrangements with a Program Coordinator. For further information, consult McMaster University's *Academic Accommodation of Students with Disabilities* policy.

Physical and Mental Health

For a list of McMaster University's resources, please refer to the Student Wellness Centre.

Academic Accommodation for Religious, Indigenous or Spiritual Observances (RISO)

Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the RISO policy. Students should submit their request to their Faculty Office ***normally within 10 working days*** of the beginning of term in which they anticipate a need for accommodation or to the Registrar's Office prior to their examinations. Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests.

Copyright and Recording

Students are advised that lectures, demonstrations, performances, and any other course material provided by an instructor include copyright protected works. The Copyright Act and copyright law protect every original literary, dramatic, musical and artistic work, **including lectures** by University instructors

The recording of lectures, tutorials, or other methods of instruction may occur during a course. Recording may be done by either the instructor for the purpose of authorized distribution, or by a student for the purpose of personal study. Students should be aware that their voice and/or image may be recorded by others during the class. Please speak with the instructor if this is a concern for you.

Extreme Circumstances

The University reserves the right to change the dates and deadlines for any or all courses in extreme circumstances (e.g., severe weather, labour disruptions, etc.). Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, A2L and/or McMaster email.