Course EP4P03_6P03
Nuclear Power Plant Systems and Operation
Undergraduate Studies/Graduate Studies
Fall 2024
Course Outline

CALENDAR/COURSE DESCRIPTION

- This course is, to a large extent, a self-study course. Students will receive the full course contents digitally and supporting documentation. Students are expected to integrate the material on their own, but also take advantage of participation in class or online discussions held. The digital material for this course is not available for general distribution. The originator of the material is Dr. George Bereznai, whose contribution and generosity are gratefully acknowledged.

- This CANDU Overview course includes: material on the science of the fission chain reaction and nuclear reactors; material on CANDU power-plant systems and their operation; self-study of the text and course material; problem-solving assignments to reinforce the understanding and application of the course material; operation of a CANDU-9 power-plant simulator. The CANDU-9 power-plant simulator was produced by CTI Simulation International visit their site to see some screen shots). Their contribution is gratefully acknowledged. .

PRE-REQUISITES AND ANTI-REQUISITES

Prerequisite(s): Registration in level IV or above of any Engineering program. Note: Having had EP4D04_6D04 (Reactor Physics) as a prior course is recommended but not a prerequisite.
Antirequisite(s):

INSTRUCTOR OFFICE HOURS AND CONTACT INFORMATION

Dr. B. Rouben

NRB-B121
roubenb@mcmaster.ca

Office Hours:

By appointment or any time by e-mail or Zoom

TEACHING ASSISTANT OFFICE HOURS AND CONTACT INFORMATION

Cahit Alkan,
alkanc@mcmaster.ca

Office Hours:
By appointment

COURSE WEBSITE/ALTERNATE METHODS OF COMMUNICATION

http://avenue.mcmaster.ca/
All Learning Modules and assignments will be on Avenue to Learn.
E-mail communications preferred to my e-mail address, rather than via Avenue to Learn.

Questions to me will be accepted to my e-mail at any time

COURSE INTENDED LEARNING OUTCOMES

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

1. Describe and explain the following features of a CANDU Generating unit:
    - the principles of overall unit operation and control
    - the functions, equipment and operation of the main process systems
    - how each major system is controlled
    - how reactor safety and the protection of the public are achieved
2. Conduct normal and abnormal operations on a simulated CANDU-9 Generating unit, including: power manoeuvres, poison override operation, recovery from a reactor trip or a turbine trip, responses to various system malfunctions.
3. Design software to follow the evolution of ^{135}Xe concentration and reactivity, and write a project report

MATERIALS AND FEES

Required Texts:

- "Nuclear Power Plant Systems and Operation"; 3 parts: Reference Text, Lecture Notes and electronic access to Learning Resources, by George Bereznai.

Recommended Additional Texts:

Calculator:

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

Other Materials:

Instructor's notes.

Recommended Additional Texts: A useful resource is:

- The Essential CANDU - a textbook about the CANDU nuclear reactor, online free access (http://www.unene.ca/essentialcandu)

COURSE FORMAT AND EXPECTATIONS

This is mostly a self-study course using the course material and the CANDU 9 simulator. The material to be covered each week is as per the list below; other topics possible. There will be 1 or 2 classes per week, to present the instructor's material and discuss topics and questions. There will be an assignment every week, 1 midterm and 1 final exam.

COURSE SCHEDULE

Date/Week	Topic	Readings
Week 1	**Introduction, NPP Safety and Systems**	
Week 2	**Overall Unit Control**	
Week 3	**Reactor and Moderator Systems**	
Week 4	**Reactor Regulating System**	
Week 5	**Reactor Regulating System**	
Week 6 (or so)	**Midterm Examination**	
Week 7	**Heat Transport Systems**	
Week 8	**HT Pressure and Inventory Control**	

Week 9	**Steam, Turbine and Feedwater Systems**
Week 10	**Major Unit Transients**
Week 11	**Unit Events**
Week 12	**Course Review**

ASSESSMENT

Component	Due Date	Weight
Weekly Assignments		25%
Midterm Exam		20%
Project		15%
Final Exam		40%
Total		100%
Special Project for Graduate (6P03) Students Only		20%

ACCREDITATION LEARNING OUTCOMES

The Learning Outcomes defined in this section are measured for Accreditation purposes only and will not be directly taken into consideration in determining a student's grade in the course.

Outcomes	Indicators
Competence in specialized engineering knowledge	1.4
Demonstrates an ability to identify a range of suitable engineering fundamentals (including mathematical techniques) that would be potentially useful for analyzing a technical problem.	2.2
Proposes solutions to open-ended problems	4.5
Creates, adapts, modifies and extends tools and techniques as appropriate to solve problems.	5.3
Assesses possible options and design configurations from a sustainability engineering perspective, which emphasizes environmental stewardship, life-cycle analysis, and long-term decision-making principles.	9.3

For more information on Accreditation, please visit: https://www.engineerscanada.ca

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 is 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.

PHYSICAL AND MENTAL HEALTH

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

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.

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.

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.

COURSE POLICY ON MISSED WORK, EXTENSIONS, AND LATE PENALTIES

1. It is the students' responsibility to regularly check the course webpage (ex. Avenue to Learn) for updates and announcements.

SUBMISSION OF REQUEST FOR RELIEF FOR MISSED ACADEMIC WORK

In the event of an absence for medical or other reasons, students should review and follow the Academic Regulation in the Undergraduate Calendar "Requests for Relief for Missed Academic Term Work".

1. **Relief for missed academic work worth less than 25% of the final grade resulting from medical or personal situations lasting up to three calendar days:**

    - Use the McMaster Student Absence Form (MSAF) on-line self-reporting tool. No further documentation is required.
    - Students may submit requests for relief using the MSAF once per term.
    - An automated email will be sent to the course instructor, who will determine the appropriate relief. Students must immediately follow up with their instructors. Failure to do so may negate the opportunity for relief.
    - The MSAF cannot be used to meet a religious obligation or to celebrate an important religious holiday.
    - The MSAF cannot be used for academic work that has already been completed attempted.
    - An MSAF applies only to work that is due within the period for which the MSAF applies, i.e. the 3-day period that is specified in the MSAF; however, all work due in that period can be covered by one MSAF.
    - The MSAF cannot be used to apply for relief for any final examination or its equivalent. See *Petitions for Special Consideration* above.

2. **For medical or personal situations lasting more than three calendar days, and/or for missed academic work worth 25% or more of the final grade, and/or for any request for relief in a term where the MSAF has been used previously in that term:**

    - Students must report to their Faculty Office to discuss their situation and will be required to provide appropriate **supporting documentation**.
    - If warranted, the Faculty Office will approve the absence, and the instructor will determine appropriate relief.

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.