Western University
Department of Mechanical & Materials Engineering

MME 4429a – Nuclear Engineering

COURSE OUTLINE – 2025-2026

CALENDAR DESCRIPTION: To present an overview of nuclear engineering beginning with the fundamentals of nuclear physics and extending to the operation of nuclear reactors with special emphasis on the CANDU nuclear reactor.

COURSE INFORMATION:

Instructor: Dr. Hamid Abdolvand

Email: Hamid.Abdolvand@uwo.ca

Lectures/tutorials/labs: See Draft My Schedule

CONSULTATION HOURS: Tuesdays, 15:15-16:15 (by appointment, please email in advance)

PREREQUISITES: Completion of third year of the Mechanical Engineering or Chemical and Biochemical Engineering Program. Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you will be removed from this course, and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

ANTIREQUISITES: None

ACCREDITATION UNITS: Engineering Science = 100%

TOPICS:

- Energy systems and climate change.
- The structure of atoms, excited atomic states and radiation.
- Interaction of radiation with matter.
- Methods of controlling a nuclear fission reaction.
- Types of fission reactors.
- CANDU reactors.
- The next generation nuclear reactor designs.
- Small modular reactors
- The operation of fusion reactors
- Radiation protection.
- Current and future state of nuclear energy in Canada and worldwide.

Students will become familiar with the basic theories behind atomic fission and the interaction of radiation with matter such that they will understand the conditions that must be met to achieve controlled nuclear criticality. The students will learn the basic operation of, and differences between, various types of nuclear fission reactors with special emphasis directed to the CANDU reactor technology.

The students will learn the basic principles, standards, and practices associated with radiation protection. Finally, the students will learn, largely through discussion, the pros- and cons- of nuclear energy as a power alternative for fossil fuel.
This course consists of 3 lectures hours per week where course information is presented and 2 tutorial hours per week where examples will be solved. Students will participate in discussions stemming from this material. Student attendance and participation in these tutorial and project discussions will constitute 20% of their mark for this course.

LEARNING OUTCOMES:

The Mechanical and Materials Engineering Program has been accredited by Canadian Engineering Accreditation Board (CEAB) of Engineers Canada. Accredited programs provide the academic requirements for licensure as a professional engineer in Canada. Western Engineering has defined indicators of the 12 Graduate Attributes (GAs) that the CEAB expects graduating engineering students to demonstrate. The connections between course learning outcomes and Western Engineering's GA Indicators are identified below.

Upon successful completion of this course, students will be able to:

- The energy available from simple fission/fusion reactions. (KB1, PA2)
- The potential energy and the energy release rate of a radioactive decay process involving either a simple decay or an isotope production/decay process (KB1, PA2).
- The intensity, and energy, of an irradiation beam after passing through a solid of given thickness (KB1, PA2, D1).
- The neutron flux profile and the conditions for nuclear criticality using a "one-group" approach for monolithic bare fast reactors of infinite planar, spherical, or cylindrical geometry (KB1, PA2, D1).
- Calculate the Roentgen Equivalent Man (REM) dosage resulting from external exposure to electromagnetic or particle irradiation, of various energy and duration, from point, line, ring, or disc source geometries with and without radiation shielding (KB1, PA2, D1).
- Discuss the consequences of nuclear accidents (IESE 1)
- Present and discuss various use of nuclear energy (CS2, ITW 3)

Graduates from this course will be able to identify the:

- Key components in the common types of fast neutron and thermal neutron fission reactors and to describe how these components are used to establish safe control of the fission reaction process (KB1, PA2, D1).
- Specific components of CANDU reactor cores and the role these components play in controlling the operation of this type of reactor (KB1, PA2, D1).

CONTACT HOURS: 3 lecture hours, 2 laboratory/tutorial hours, half course

TEXTBOOK: "Introduction to Nuclear Engineering" 4/e, John R. Lamarsh and Anthony J. Baratta. Prentice Hall, ISBN 0134570057

https://www.pearson.com/

Students are welcome to purchase second-hand or earlier editions of this textbook.

UNITS: SI will be used; however, other units may be introduced through examples as required.

EVALUATION: Two 1½ hour, term tests to be held during tutorials (Oct 17) or lecture hours (Nov 14). Three-hour final examination.

Two Term Tests	30% (Oct 17, Nov 14)
Participation in tutorials and project presentations	8%
Project	12%
Final exam	50%

COURSE POLICIES: The following course specific policies will be enforced throughout the course:

Tutorials:

Failure to attend more than 40% of the tutorials will translate into a zero mark for attendance.

Missing a tutorial without academic consideration will translate into a zero mark for that tutorial.

Students who arrive 30 min after the scheduled tutorial will not get any attendance credit for that tutorial.

Project:

If a minimum of 50% is not obtained, everyone in the project team will get a zero for the project mark.

You may use a GenAI tool to help you brainstorm or frame your initial ideas for the project. However, your final submission must be entirely in your own words and demonstrate your individual experience and insight.

Midterm and Final exams:

If a mark of less than 50% is obtained on the final examination, the student cannot receive a final mark greater than 48%.

Only non-programmable calculators will be allowed during all exams.
No make-up term-test options will be offered regardless of the circumstances for which the midterm was missed.

Missing any of the term-test exams with academic consideration will automatically shift the weight of the missed midterm exam into the final exam.

Missing either (or any) of the term tests without academic consideration will translate to zero mark for that exam.

If both term tests are missed (with or without academic consideration), the student will be debarred from taking the final exam.

All exams are closed-resource. The use of generative AI is prohibited and monitored under university policies regarding unauthorized assistance.

General Faculty / University Policies

The Faculty of Engineering and Western University have overarching policies that prescribe how undergraduate courses should run. The course-specific policies described above should be considered *in addition to* those overarching policies, or as course-specific interpretations of them. In the event of contradictions or confusion between course-specific policies above and general Faculty / University policies, please contact your course instructor for clarification.

Western Engineering's undergraduate polices can be found by navigating to:
https://www.eng.uwo.ca/undergraduate/academic-support-and-accommodations/policies.html

and then clicking the "*Engineering Undergraduate Policies framework*" link.