Engineering Physics
NUCENG 3D04
Principles of Nuclear Engineering
Fall 2026

McMaster University

ENGINEERING

Instructor Information

Markus Piro
Email: pirom@mcmaster.ca
Office Hours:
Mondays @ 13-14 h, NRB 105

Thursdays @ 12-13 h, NRB 105

Course instructor

Joey Ruska
Email: rucskajj@mcmaster.ca
Office Hours:
By appointment

Lab instructor

TA Information

Name: TAs will be announced on A2L

Class Times

Lectures will be held on the following days (except reading week and stat. holidays):

- Mondays @ 10:30 – 11:20 h
- Wednesdays @ 10:30 – 11:20 h
- Thursdays @ 10:30 – 11:20 h

Tutorial schedule:

- The tutorials run every week on Monday at 11:30 – 12:20 h except week #1 and reading week.

Labs:

- Laboratory experiments will occur during the time period for your assigned lab section. Your lab section is visible on your Mosaic class schedule. A schedule of the individual experiments will be available on A2L.

Class Format

The course will be organized as follows:

- Three lectures per week (in-person attendance only)
- One tutorial per week
- Four labs per term

Problem Sets will be posted to A2L to help students practice applying the theories described in-class. Solutions to those problem sets will also be posted to A2L.

Course assessments are as follows:

1. **Quizzes** will be given during tutorials in-person and are intended to help students stay on top of course material. All quizzes will be open textbook but closed notes. Electronics are not permitted except a university approved calculator. Students that regularly attend lectures and attempt homework problems should find quizzes straightforward. Note the assessment section, which describes two options for students: option A includes quizzes, while option B does not.
2. **Lab reports** will be written individually based on the labs that they performed in co-ordination with the Lab Instructor. Students are expected to review the lab manual (available on A2L) prior to every lab and are encouraged to ask questions. The written report should follow

the Report Writing Guidelines document for 3D04 and will be evaluated using the lab report evaluation form (both provided on A2L). Students will receive feedback on their reports, which should be applied in subsequent reports. The labs are intended to provide students with hands-on experience in the application of nuclear science & engineering concepts. There will be two formal lab reports for labs #1 and #2, and two lab assignments for the remaining labs. Details will be on A2L. Students are permitted to use AI in the creation of these documents, but must declare that AI was used and how it was used.

3. There will be a **lab exam** written in-class towards the end of the semester. The exam is intended to ensure students understand the concepts covered in each lab.
4. There will be a **final exam** that will include content discussed in-class, material referenced in the textbook, and the quizzes. Labs will be out of scope from the exams. The exam will be open textbook but closed notes. Students are expected to have a physical textbook with them in exams to reference figures and tables. The standard McMaster calculator will be permitted but no other electronics (e.g., laptops, smart phones, smart watch, etc.).

To maximize your success in this course, you should:

1. Attend lectures and tutorials, review lecture slides, and read textbook chapters assigned in class.
2. Work on practice problems as homework every week.
3. Frequently review A2L for course information.
4. Engage with the prescribed pre-lab material and ask questions if anything is unclear.
5. Work with your peers to ensure you understand course content.
6. Aim to understand concepts and not just memorize content.
7. Ask questions during lectures, tutorials, and office hours if anything is unclear. We're happy to help!

Course Dates: 09/08/2026 - 12/10/2026

Units: 4.00

Course Delivery Mode: In Person

Course Description: Introduction to fission energy systems. Energetics of nuclear reactions, interactions of radiation with matter, radioactivity, design and operating principles of fission reactors. Students perform labs involving the McMaster Nuclear Reactor to gain an understanding of the nuclear

physics processes underlying its operation and its applications. Three lectures, one tutorial, one lab (three hours) four times per term; fall term Prerequisite(s): Registration in Level III or above and credit in at least one of the following: BIOPHYS 1S03, LIFESCI 1D03, MEDPHYS 1E03, PHYSICS 1AA3, 1CC3, 1E03, ISCI 1A24 A/B, ENGTECH 4TF3, or both ENGTECH 1PH3 and 1EL3 Antirequisite(s): ENGPHYS 3D03, 3D04

Important Links

- Mosaic
- Avenue to Learn
- Student Accessibility Services - Accommodations
- McMaster University Library
- eReserves
- Open Education Resources

Course Learning Outcomes

- Conceptualise and explain the fundamental physical phenomena related to nuclear physics, including fission, radioactive decay, and related mechanisms.
- Calculate neutron transport equations, including flux, reactor kinetics, and reactivity.
- Describe at a high level nuclear reactor designs, including major components, heat transport systems, and matters related to reactor safety.
- Calculate values relevant to radiation protection and shielding.
- Demonstrate competency in the operation of standard nuclear equipment, including adherence to related safety procedures.

Graduate Attributes

The Canadian Engineering Accreditation Board (CEAB) is a division of Engineers Canada and is responsible for accrediting undergraduate engineering programs across Canada. Accreditation by the CEAB ensures that the engineering programs meet a national standard of quality and cover essential educational requirements. Graduate Attributes are a set of

qualities and skills that the CEAB expects engineering graduates to possess. These attributes are a benchmark for the learning outcomes of accredited engineering programs. This section lists the Graduate Attribute Indicators associated with the Learning Outcomes in this course.

- GA1: A KNOWLEDGE BASE FOR ENGINEERING
  - Indicator 1.2, competence in Natural Science
- GA1: A KNOWLEDGE BASE FOR ENGINEERING
  - Indicator 1.4 - Competence in Specialized Engineering Knowledge
- GA3: INVESTIGATION
  - Indicator 3.1 Selects appropriately from relevant knowledge base to plan appropriate data collection methods and analysis strategies.

Lab Information

Students are required to take a total of four (4) labs in-person -- two specific labs are required for every student to take while the other two labs students can pick from a list. A schedule will be posted on A2L at the beginning of the term.

Labs include (* required):

1. Introduction to Gamma Detection*
2. Radioactive Decay & Neutron Activation Analysis*
3. Neutron Attenuation
4. Neutron Radiography
5. Gamma Attenuation & Hot Cells
6. Radiation Safety & Surface Contamination Monitoring

Each lab will occur over a single 3 hour session. If the lab facilities become unavailable for any reason, data will be made available by the Laboratory Supervisor, and students will complete the lab reports based on the supplied data. Laboratory manuals and deliverables due dates are on A2L.

Lab Safety

The Faculty of Engineering is committed to McMaster University's Workplace and Environmental Health and Safety Policy which states:

"Students are required by University policy to comply with all University health, safety and environmental programs". It is your responsibility to understand McMaster University Workplace and Environmental Health and Safety programs and policies. For information on these programs and policies please refer to McMaster University Health and Safety. The Lab Safety Handbook is available here, as well as on A2L.

It is also your responsibility to follow any specific Standard Operating Procedures (SOPs) provided for some of the experiments and the laboratory equipment. A laboratory-specific set of rules can also be added to ensure that students fully understand laboratory safety rules that are in place prior to their first session.

Course Schedule

A weekly breakdown of the course schedule (schedule may change)

Week	Topic	Assessment
1	Admin + intro to nuclear	
2	Atomic and nuclear physics	Quiz #1
3	Interaction of radiation with matter	Quiz #2
4	Nuclear reactor design	Quiz #3
5	Nuclear engineering topics	Quiz #4
Midterm Break		
6	Guest lecture	
7	Neutron diffusion and moderation	Quiz #5
8	Nuclear reactor theory	Quiz #6
9	Reactor kinetics	Quiz #7
10	Heat transfer in a nuclear reactor	Quiz #8
11	Radiation protection	Quiz #9
12	Radiation shielding	Quiz #10
13	Safety and licensing	Quiz #11

Required Materials and Texts

Please sign in with your MacID here to view your booklist

Introduction to Nuclear Engineering
Authors: J.R. Lamarsh, A.J. Baratta
Publisher: Pearson
Edition: Both 3rd and 4th editions are acceptable

The campus bookstore sells it for $225 + tax, which is expensive. Students are encouraged to buy a used copy at a more reasonable price.

Course Evaluation

The top ten quizzes will be taken. There are two assessment options for students (A or B), as indicated below. The highest mark will be taken, which will not take effect on A2L until the end of the year.

	Option A	Option B
Quizzes (10)	20%	0%
Lab reports/assignments (4)	20%	20%
Lab exam (1)	20%	20%
Final exam (1)	40%	60%

Course Evaluation Details

Students wanting to have any deliverable re-assessed will have two weeks from the time the deliverable is returned to the student. Please first see the TA for reconsideration before seeing the instructor.

Completion of four laboratory experiments, passing the lab exam, and passing the final exam are required to pass this course.

Undergraduate Grading Scale

The McMaster 12 Point Grading Scale

Grade	Equivalent Grade Point	Equivalent Percentages
A+	12	90-100
A	11	85-89
A-	10	80-84
B+	9	77-79
B	8	73-76
B-	7	70-72
C+	6	67-69
C	5	63-66
C-	4	60-62
D+	3	57-59
D	2	53-56
D-	1	50-52
F	0	0-49

Absences, Missed Work, Illness

Following the principles of Universal Design for Learning (UDL), lab reports will have a due date and then a closing date a few days later, effectively building in an MSAF accommodation into every lab report. Therefore, MSAFs do not apply to lab reports.

MSAF'd quizzes will result in reweighing the quiz grade to other deliverables (Option A only).

Generative AI: Some Use Permitted

Students may freely use generative AI in this course so long as the use of generative AI is referenced and cited following citation instructions given in the syllabus. Use of generative AI outside assessment guidelines or without citation will constitute academic dishonesty. It is the student's responsibility to be clear on the expectations for citation and reference and to do so appropriately.

Turnitin.com

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.

APPROVED ADVISORY STATEMENTS

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.

The following illustrates only three forms of academic dishonesty:

- plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.
- improper collaboration in group work.

- copying or using unauthorized aids in tests and examinations.

Authenticity / Plagiarism

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. Avenue to Learn, 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

Some courses may use on-line elements (e.g. e-mail, Avenue to Learn, 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.

Requests for Relief for Missed Academic Term Work

In the event of an absence for medical or other reasons, students should review and follow the Policy on Requests for Relief for Missed Academic Term Work.

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, Avenue to Learn and/or McMaster email.