ENG PHYS 3D03
Principles of Nuclear Engineering
Fall/Winter 2016/17
Course Outline

CALENDAR/COURSE DESCRIPTION

January 4 – April 6, 2017. The course will start on Friday, January 6, 2016.
Learn the knowledge on nuclear engineering which the 3rd level nuclear engineering students in the top ranked universities in the world are studying through lecture, Lab., and self-oriented learning.

PRE-REQUISITES AND ANTI-REQUISITES

Prerequisite(s): N/A
Antirequisite(s): N/A
In order to master the knowledge and skills on basic nuclear engineering by which students will be able to compete with the nuclear engineering students in the world in their near future, Instructors recommend students to take 3L04, 3O04, 4D03, 4P03, and 4U04.

INSTRUCTOR OFFICE HOURS AND CONTACT INFORMATION

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By appointment

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TEACHING ASSISTANT OFFICE HOURS AND CONTACT INFORMATION

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COURSE WEBSITE/ALTERNATE METHODS OF COMMUNICATION

http://engphys.mcmaster.ca/undergrad-studies/ug-courses/
http://avenue.mcmaster.ca/

COURSE OBJECTIVES

A successful student will be able to do the following by the end of the course:

- Understand the fundamental physical phenomena and processes relevant to nuclear reactors.
- Understand the fundamental physical and chemical processes relevant to nuclear fuel cycle and radioactive waste management.
- Understand the physics, chemistry and biology in the radiation, the interaction of radiation with matter (including human body), and the fundamentals of radiation detection. Apply these physics, chemistry and biology to design the radiation shielding.
- Understand how the nuclear power plant is designed and operated and how the safety of nuclear power plant is secured.

Note: Many of students have to create and/or hunt the jobs outside Canada. CANDU is a unique and excellent reactor, but it is minor in the world market. So, in this course, students will mainly learn the nuclear engineering related to BWR and PWR. CANDU also be learnt in the last part of the course.

MATERIALS AND FEES

Required Texts:
- Introduction to Nuclear Reactor Theory, by John R. Lamarsh.
  This is sold at Book Shore of university, and also available at http://www.ans.org/store/item-300030/.
  This is also available in the library of university.
  This is an expensive book, but a book which all nuclear stream students in the world read.
- Other materials students are recommended to study will be posted in Avenue to Learn.

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

Other Materials for your further studies:
- M. Benedict, T. H. Pigford, H. Levi, Nuclear Chemical Engineering, Mcgraw-Hill (1981).
- G. F. Knoll, Radiation Detection and Measurement, Wiley (2010).

Students can have a lot of information from the WWW sites of International Atomic Energy Agency, American Nuclear Society, Canada Nuclear Society and other international organizations (e.g. OECD, Canada-CNSC, Canada-CAN, OPG, US-NRC, NEI, WANO, EPRI etc.) and academic societies.

COURSE OVERVIEW

Tentative schedule (schedule may change):

1/6/F Guidance & Group Inquiry Learning (grouping/confirmation)

Reactor Physics

1/9/M Interaction of neutron with matter
1/11/W Fission reaction and chain reaction
1/13/F Diffusion of neutron
1/16/M Neutron Moderation with/without Absorption
1/18/W Fermi theory in reactor 1
1/20F Fermi theory in reactor 2
1/23/M Group Inquiry Learning 1 - Peer Review of "Background & Purpose"
1/25/W Multi-regional reactor

Reactor Kinetics

1/27/F Reactor kinetics (Point rector kinetics) 1
1/30/M Reactor kinetics (Point rector kinetics) 2
2/1/W Effect of temperature on reactivity
2/3/F Group Inquiry Learning 2 - Peer Review of "Analysis & Methodology"
2/6/M Reactor control (transfer function, Xe stability)
2/8/W Operation control of BWR and PWR 1
2/10/F Operation control of BWR and PWR 2

Design of LWR

2/13/M Burn-up and reactivity control
2/15/W Group Inquiry Learning 3 - Peer Review of "Finding & Evaluation" (TAs lead the peer-review)
2/17/F Design of reactor 1

2/20 Winter Break
2/22 Winter Break
2/24 Winter Break

2/27/M Reserved for Make-Up
3/1/W Design of reactor 2

Nuclear Fuel Cycle & Radioactive Waste Management

3/3/F Enrichment & isotope separation
3/6/M Group Inquiry Learning 4 - Peer Review of "Stakeholders, Relationship with society, Conclusions & Recommendation"
3/8/W Reprocessing
3/10/F Waste management

Radiation (Dr. Dave Tucker)

3/13/M Radiation and Radiation Detection
3/15/W Health Physics
3/17/F Reserved for Make-Up

CANDU (Dr. Victor Snell)

3/20/M Design of CANDU reactor system
3/22/W Safety and future of CANDU
3/24/F Reserved for Make-Up

Presentation on Group Inquiry Learning

3/27/M (tentative) *Special Lecture by Nuclear Waste Management Organization (NWMO)*
3/29/W Presentation 1
3/31/F Presentation 2
4/3/M Presentation 3
4/5W Reserved for Make-Up

Laboratory Schedule

Each of the laboratory experiments occurs over a single 3-hour session. Experiments begin at 2:30pm. Attendance and completion of each laboratory experiment, and submission of all Lab reports are mandatory. If the lab facilities become unavailable for any reason, data will be made available by the Instructor and Laboratory Supervisor, and the students will complete the lab reports based on the supplied virtual data. The Laboratory Manual is available on Avenue to Learn.

The followings are **Tables for Neutron Activation Analysis**

Table 1 – Neutron Activation Properties of Isotopes in Nature
http://www3.sympatico.ca/bdiacon/Table_1_Properties_of_Isotopes.htm
Table 2 – Neutron Activation Properties of Isotopes Useful in Neutron Activation Analysis
http://www3.sympatico.ca/bdiacon/Table_2_Isotopes_Useful_for_NAA.htm
Table 3 – Gamma Ray Energy Peaks& Intensities Arranged by Increasing Energy
http://www3.sympatico.ca/bdiacon/Table_3_Gamma_Rays_Arranged_by_Energy.htm
Table 4 – Gamma Ray Energy Peaks& Intensities Arranged by Increasing Half-Life
http://www3.sympatico.ca/bdiacon/Table_4_Isotopes_Arranged_by_Half-Life.htm
Table 5 – Thorium Decay Series Arranged by Increasing Energy
http://www3.sympatico.ca/bdiacon/Table_5_Thorium_Decay_Series.htm
Table 6 – Uranium Decay Series Arranged by Increasing Energy
http://www3.sympatico.ca/bdiacon/Table_6_Uranium_Decay_Series.htm

ASSESSMENT

Component	Weight
Assignments (total 4 assignments)	12% (3% per assignment)
Lab. Reports	30%
Group Inquiry Learning	21% (4% Peer-review of memos; 8% presentation; 9% report)
Report on Special Lecture	2% (if Special Lecture is conducted)
Final Exam	35% (37% if the Special Lecture is not conducted)

Total	100%

Attendance in the lecture (**except Special Lecture, Group Inquiry Learning Presentation & Laboratories**) is not checked.
The presentation, the full attendance during Group Inquiry Learning Presentation (3 days), submission of memos for peer review, the questions to other group's presentation at Group Inquiry Learning Presentation, and the report are required for the grade of Group Inquiry Learning. Details will be explained in the 1st class.
Final Exam will cover the assignments, the exercise questions given in the classes and the course materials (details will be explained in the 1st class and last of class), but will not cover the Special Lecture, Laboratories, and Group Inquiry Learning. Taking the Final Exam is mandatory.

Assignments:
Assignments will be posted on Avenue to Learn after notification during the classes. Assignments received after the deadline will not be graded.

Group Inquiry Learning:
4 students/group (3-students-group is acceptable, but 2 or 5-students-group is not acceptable). Peer-review using progress memo will be conducted. Make the oral presentation by PPT. PPT or PDF file for presentation should be submitted in advance. Details will be explained in the class.
The grade will be evaluated by rubrics of the peer-review, the presentation and the questions & answers, and the report. One presentation and One report per group.
Each group decide its own subject on nuclear energy system in 21st century, and conduct the self-oriented/self-directed study from the view point of environmental, economic and societal sustainability. Subjects are (i) feasibility of implementation of nuclear power station in Alberta, (ii) possibility of export of CANDU reactor to India, (iii) reality of reprocessing/Pu use in Canada, (iv) why 22 municipalities in Canada have expressed their interest to host the used nuclear fuel repository, and (v) contribution of nuclear energy to the best energy mix in Australia, for example.
In the first three sessions, students can study their own project from the science and technology point of view. In the fourth session, students are expected to study the stakeholders around their project, and discuss the environmental, economic and societal sustainability on their project.

Laboratory:
The labs will be scheduled with the Laboratory Supervisor. In the event that labs become unavailable for any reason, virtual data will be supplied to each student so that the lab reports can be completed. Details will be explained in the first lecture. On-time attendance will be required. A late penalty of 10% per delay will be deducted from the laboratory report mark.
Laboratory reports will be due within two weeks following completion of each laboratory to the Drop Box on Avenue to Learn (one week of Winter Break is not included in the two weeks); a late penalty of 15% per day will be deducted.
Attendance and Laboratory reports to all Labs required are mandatory.
Students are reminded of the University Policy on academic dishonesty related to assignment and laboratory work. In addition to the pursuit of knowledge, all labs have the goal of teaching students the craft of properly writing an experimental laboratory report.

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 actual grade in the course.

Outcomes	Indicators
1. Understand the fundamental physics, chemistry, biology and mathematics relevant to design and manage the nuclear reactor, nuclear fuel cycle and radioactive waste management.	1.4 Assignment, Lab. Report, Final Exam
2. Understand the relationship between nuclear technology and global society.	1.4 Group Inquiry Learning
3. Demonstrate the ability to apply the knowledge on nuclear science and engineering relevant to nuclear engineering to design the nuclear power systems.	4.2 Assignment, Lab. Report, Final Exam
4. Demonstrate the ability to integrate the knowledge on nuclear science and engineering with safety criteria and regulations	4.6 Assignment, Final Exam, Group Inquiry Learning
5. Critically evaluate and apply knowledge and skills procured through self-directed and self-identified sources.	12.1 Group Inquiry Learning

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

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.

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.

It is your responsibility to understand what constitutes academic dishonesty. For information on the various types of academic dishonesty please refer to the Academic Integrity Policy, located at http://www.mcmaster.ca/academicintegrity

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.

ACADEMIC ACCOMMODATIONS

Students who require academic accommodation must contact Student accessibility Services (SAS) to make arrangements with a Program Coordinator. Academic accommodations must be arranged for each term of study. Student Accessibility Services can be contact by phone at 905.525.9140 ext. 28652 or e-mail at sas@mcmaster.ca. For further information, consult McMaster University's Policy for Academic Accommodation of Students with Disabilities.

NOTIFICATION OF STUDENT ABSENCE AND SUBMISSION OF REQUEST FOR RELIEF FOR MISSED ACADEMIC WORK

1. The McMaster Student Absence Form is a self-reporting tool for Undergraduate Students to report absences DUE TO MINOR MEDICAL SITUATIONS that last up to 3 days and provides the ability to request accommodation for any missed academic work. Please note this tool cannot be used during any final examination period.
2. You may submit a maximum of 1 Academic Work Missed request per term. It is YOUR responsibility to follow up with your Instructor immediately (NORMALLY WITHIN TWO WORKING DAYS) regarding the nature of the accommodation. Relief for missed academic work is not guaranteed.
3. If you are absent for reasons other than medical reasons, for more than 3 days, or exceed 1 request per term you MUST visit the Associate Dean's Office (JHE/A214). You may be required to provide supporting documentation.
4. This form must be submitted during the period of absence or the following day, and is only valid for academic work missed during this period of absence.
5. It is the prerogative of the instructor of the course to determine the appropriate relief for missed term work in his/her course.
6. You should expect to have academic commitments Monday through Saturday but not on Sunday or statutory holidays. If you require an accommodation to meet a religious obligation or to celebrate an important religious holiday, you may submit the Academic Accommodation for Religious, Indigenous and Spiritual Observances (RISO) Form to the Associate Dean's Office. You can find all paperwork needed here: http://www.eng.mcmaster.ca/current/documents.html

NOTICE REGARDING POSSIBLE COURSE MODIFICATION

The instructor and university reserve the right to modify elements of the course during the term. The university may change the dates and deadlines for any or all courses in extreme circumstances. If either type of modification becomes necessary, reasonable notice and communication with the students will be given with explanation and the opportunity to comment on changes. It is the responsibility of the student to check their McMaster email and course websites weekly during the term and to note any changes.

TURNITIN.COM STATEMENT

In this course we will be using a web-based service (Turnitin.com) to reveal plagiarism. Students will be expected to submit their work electronically to Turnitin.com and in hard copy so that it can be checked for academic dishonesty.

Students who do not wish to submit their wok to Turnitin.com must still submit a copy to the instructor. No penalty will be assigned to a student who does not submit work to Turnitin.com. All submitted work is subject to normal verification that standards of academic integrity have been upheld (e.g., on-line search, etc.). To see the Turnitin.com Policy, please go to http://www.mcmaster.ca/academicintegrity/.

ON-LINE STATEMENT FOR COURSES REQUIRING ONLINE ACCESS OR WORK

In this course, we will be using Avenue to Learn. Students should be aware that, when they access the electronic components of this course, 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 this course will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure, please discuss this with the course instructor.

REFERENCE TO RESEARCH ETHICS

The two principles underlying integrity in research in a university setting are these: a researcher must be honest in proposing, seeking support for, conducting, and reporting research; a researcher must respect the rights of others in these activities. Any departure from these principles will diminish the integrity of the research enterprise. This policy applies to all those conducting research at or under the aegis of McMaster University. It is incumbent upon all members of the university community to practice and to promote ethical behaviour. To see the Policy on Research Ethics at McMaster University, please go to
http://www.mcmaster.ca/policy/faculty/Conduct/ResearchEthicsPolicy.pdf.