UNSW Course Outline

ZPEM1508 Nuclear Science and Applications - 2024

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General Course Information

Course Code : ZPEM1508
Year : 2024
Term : Semester 2
Teaching Period : Z2
Is a multi-term course? : No
Faculty : UNSW Canberra
Academic Unit : UC Science
Delivery Mode : In Person
Delivery Format : Standard
Delivery Location : UNSW Canberra at ADFA
Campus : UNSW Canberra
Study Level : Undergraduate
Units of Credit : 6

Useful Links

Handbook Class Timetable

Course Details & Outcomes

Course Description

The course will provide students with a fundamental understanding of nuclear physics, leading to an appreciation of the principles associated with nuclear power and their applications in a military context, particularly in regards to naval energy and propulsion. The course will introduce

nuclear fusion, fission and reactor science, as well as the important topics of general radiation safety and regulatory frameworks as they apply to the Australian Defence Force.

Course Aims

The aim of the course is to introduce students to nuclear science and radiation protection in the context of the Australian Defence Force (ADF). It will allow them to be knowledgeable at a general level about the topic and be able to interact in an informed manner with those with more specialist knowledge. It will also provide prerequisite knowledge to students for University or in-service courses undertaken at a later stage in their ADF careers.

Relationship to Other Courses

This is a stand-alone elective for BSc, BA, BBus and BCompCybSec.

For BSc students, it can provide context for ZPEM3528 - Nuclear Physics.

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Explain fundamental nuclear physics properties and processes, including nuclear structure, fission and fusion.
CLO2 : Determine risk to health and environment from different radiation doses.
CLO3 : Articulate how fundamental nuclear physics underpins different reactor technologies.
CLO4 : Describe the responsibilities inherent in use of nuclear technology.
CLO5 : Communicate scientific and technical concepts in written and verbal formats.

Course Learning Outcomes	Assessment Item
CLO1 : Explain fundamental nuclear physics properties and processes, including nuclear structure, fission and fusion.	• Week 4 test • Weekly quizzes • Week 7 test • Group oral presentation
CLO2 : Determine risk to health and environment from different radiation doses.	• Week 4 test • Weekly quizzes • Week 7 test • Group oral presentation
CLO3 : Articulate how fundamental nuclear physics underpins different reactor technologies.	• Essay • Weekly quizzes • Group oral presentation
CLO4 : Describe the responsibilities inherent in use of nuclear technology.	• Essay • Weekly quizzes • Group oral presentation
CLO5 : Communicate scientific and technical concepts in written and verbal formats.	• Essay • Group oral presentation

Learning and Teaching Technologies

Moodle - Learning Management System | Echo 360

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Week 4 test Assessment Format: Individual	15%	Due Date: 09/08/2024 04:10 PM
Weekly quizzes Assessment Format: Individual	12%	Start Date: Not Applicable Due Date: Not Applicable
Essay Assessment Format: Individual Short Extension: Yes (2 days)	28%	Due Date: Folio due Friday 27/9 1800h, final essay due Wednesday 16/10 1800h.
Week 7 test Assessment Format: Individual	15%	Due Date: 13/09/2024 04:10 PM
Group oral presentation Assessment Format: Group	30%	Due Date: Exam week, date TBA.

Assessment Details

Week 4 test

Assessment Overview

This early-semester test cements students' grasp of the fundamental physics taught in Weeks 1 to 4, before its applications are explored in later weeks. It is thus summative. It is designed to bring non-STEM students up to the knowledge level and vocabulary needed for the rest of the course, and is thus competency-based in style and will focus on definitions.

Course Learning Outcomes

- CLO1 : Explain fundamental nuclear physics properties and processes, including nuclear structure, fission and fusion.
- CLO2 : Determine risk to health and environment from different radiation doses.

Assessment Length

45 minutes

Submission notes

In-class test. No written materials permitted.

Assignment submission Turnitin type

Not Applicable

Weekly quizzes

Assessment Overview

12 x 1% each, weeks 2-13.

Short answer and multiple choice, which are formative in nature.

The quizzes for week 2 to 6 inform the Week 4 and Week 7 tests, and the week 7 to 13 quizzes ensure the students engage with the full applications material once they are predominantly focused on the specific topic of their essay and oral presentations.

Course Learning Outcomes

- CLO1 : Explain fundamental nuclear physics properties and processes, including nuclear structure, fission and fusion.
- CLO2 : Determine risk to health and environment from different radiation doses.
- CLO3 : Articulate how fundamental nuclear physics underpins different reactor technologies.
- CLO4 : Describe the responsibilities inherent in use of nuclear technology.

Assessment Length

20 minutes, several multichoice or numerical answer questions.

Submission notes

Single attempt. Quizzes open after the first workshop of the week, and close before the first workshop the week after.

Assignment submission Turnitin type

Not Applicable

Essay

Assessment Overview

The formative 1500- to 2000-word essay is designed to build students' contribution for their chosen topic for their summative group oral presentation. As an example, if a group's project is to compare different reactor types, the matter of the essay may be for each group member to describe a different technology.

14% will be for a research folio, which should comprehensively list the references used and the content from them used to inform the essay. It should be the only document required to write the subsequent essay. For the folio component of the essay only, Generative AI may be used for PLANNING ASSISTANCE. This means that, as this assessment task involves some planning or

creative processes, you are permitted to use software to generate initial ideas. However, you must develop or edit those ideas to such a significant extent that what is submitted is your own work, i.e. only occasional AI generated words or phrases may form part of your submission for the Final Essay. Copies of the initial prompts and outputs must be turned in with the folio, to prevent any uncertainty about the originality of your work.

The other 14% will be for the final essay. It is a requirement that the essay is a development of the folio material - only parts which can been reasonably seen to be derived from the folio or feedback on it will be assessed.

Course Learning Outcomes

- CLO3 : Articulate how fundamental nuclear physics underpins different reactor technologies.
- CLO4 : Describe the responsibilities inherent in use of nuclear technology.
- CLO5 : Communicate scientific and technical concepts in written and verbal formats.

Assessment Length

Folio of varying length, final essay of 1500 to 2000 words.

Assignment submission Turnitin type

This assignment is submitted through Turnitin and students can see Turnitin similarity reports.

Week 7 test

Assessment Overview

This test examines students' knowledge of the final weeks of science material, before it is used for applications. It is thus summative. This test in not competency based, and will instead assess students' ability to explain and use scientific concepts.

Course Learning Outcomes

- CLO1 : Explain fundamental nuclear physics properties and processes, including nuclear structure, fission and fusion.
- CLO2 : Determine risk to health and environment from different radiation doses.

Assessment Length

45 minutes

Submission notes

In-class test. No written materials permitted.

Assignment submission Turnitin type

Not Applicable

Group oral presentation

Assessment Overview

The oral presentation takes the individual group members essay topics and forms them into a broader overview of a topic. Despite the oral presentation being delivered as a group, each student will receive an individual mark.

As the oral presentation is the major summative assessment, marking will be rigorous. The quizzes, first test and assignment are designed to assess to the minimum standard required to meet the learning outcomes. The oral presentation is designed to distinguish between different overall grades.

Course Learning Outcomes

- CLO1 : Explain fundamental nuclear physics properties and processes, including nuclear structure, fission and fusion.
- CLO2 : Determine risk to health and environment from different radiation doses.
- CLO3 : Articulate how fundamental nuclear physics underpins different reactor technologies.
- CLO4 : Describe the responsibilities inherent in use of nuclear technology.
- CLO5 : Communicate scientific and technical concepts in written and verbal formats.

Assessment Length

15 minutes + 5 minutes questions

Assignment submission Turnitin type

Not Applicable

General Assessment Information

Referencing

Any referencing style that allows a reference document to be located is sufficient.

Use of Generative Artificial Intelligence (AI) - such as ChatGPT

For the Research component of the Essay only, due Week 8, Generative AI may be used for PLANNING ASSISTANCE.

This means that, as this assessment task involves some planning or creative processes, you are permitted to use software to generate initial ideas. However, you must develop or edit those ideas to such a significant extent that what is submitted is your own work, i.e. only occasional AI generated words or phrases may form part of your submission for the Draft Essay (Week 10) and

Final Essay (Week 12). Copies of the initial prompts and outputs must be turned in at Week 8, to prevent any uncertainty about the originality of your work.

If the outputs of Generative AI such as ChatGPT form a part of your Draft and Final Essay submission, it will be regarded as serious academic misconduct and subject to the standard penalties, which may include 00FL, suspension and exclusion.

For all other assessments, NO ASSISTANCE may be provided by Generative AI.

This means that it is prohibited to use any software or service to search for or generate information or answers. If its use is detected, it will be regarded as serious academic misconduct and subject to the standard penalties, which may include 00FL, suspension and exclusion.

Missed assessments

Quizzes are open for a full week, so reasons for missing a quiz must span a whole week to have the quiz, or a supplimental quiz, made available after closure.

Supplimentary tests to replace the Week 4 or Week 7 test may be made available, via the standanr special consideration procedure.

Students unable to attend the group oral presentation may possibly have an alternative day arranged, subject to the special consideration procedure.

Grading Basis

Standard

Requirements to pass course

The assessment for the course has been designed so that an overall mark of 50% or greater indicates that the student has unambiguously demonstrated satisfactory completion of each learning outcome. For this reason, and consistent with the UNSW policy of abolishing the Pass Conceded grade, students who receive less than 50% overall for the course will receive a fail grade.

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 15 July - 19 July	Lecture	Energy, atoms & nuclear structure
	Workshop	Energy, atoms & nuclear structure
Week 2 : 22 July - 26 July	Lecture	Radioactivity
	Workshop	Radioactivity
Week 3 : 29 July - 2 August	Lecture	Interaction of radiation & matter
	Workshop	Interaction of radiation & matter
Week 4 : 5 August - 9 August	Workshop	Revision
	Assessment	Week 4 test, during 2nd workshop session.
Week 5 : 12 August - 16 August	Lecture	Fussion & fission
Week 6 : 19 August - 23 August	Lecture	Biological effects of radiation & radiation protection
	Workshop	Biological effects of radiation & radiation protection
Week 7 : 9 September - 13 September	Lecture	Nuclear fuel
	Assessment	Week 7 test in 2nd workshop session.
Week 8 : 16 September - 20 September	Lecture	Reactors I: Basics
	Workshop	Reactors I: Basics
Week 9 : 23 September - 27 September	Lecture	Reactors II: Types
	Workshop	Reactors II: Types
	Assessment	Essay Folio due, end of 2nd workshop session.
Week 10 : 30 September - 4 October	Lecture	Nuclear propulsion
	Workshop	Nuclear propulsion
Week 11 : 7 October - 11 October	Lecture	Safety & Incidents
Week 12 : 14 October - 18 October	Lecture	Radioactive waste
	Workshop	Radioactive waste
	Assessment	Final Essay due, end of 1st workshop session.
Week 13 : 21 October - 25 October	Lecture	Nuclear law
	Workshop	Nuclear law

Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings. Students are indeed expected to attend all lectures, tutorials, laboratory sessions and assessments unless their absence has been approved by the course coordinator. Students who have missed assessments or a laboratory, or expect to miss such a requirement, must inform the course coordinator by email at the earliest practicable date:

In typical circumstances of missed assessments, a formal application for Special Consideration via the prescribed University procedure may be appropriate. Alternative assessment can then be arranged. Otherwise, in the case of absence a mark of zero will be awarded for the assessment. Further information is available under 'assessments'.

Course Resources

Prescribed Resources

Raymond L. Murray and Keith E. Holbert
Nuclear Energy, 8th Ed.
(Butterworth-Heinemann, 2020)
This up-to-date text covers both fundamental nuclear physics concepts and their technological application in one volume. Available digitally and in hard copy.
Readings are assigned for each week, and it is highly recommended that you read them before the first workshop.

Moodle has pre-recorded lectures for weeks 1 to 6.

Recommended Resources

J. A. Mahaffey
Atomic Accidents
(Pegasus Books, 2014)
Expands on Chapter 21 of Murray and Holbert, and is of particular use for the oral and technical report assessment items.

Craig Mazin
Cherobyl
(HBO, 2019)
This television miniseries dramatises the 1986 nuclear disaster at the Chernobyl Nuclear Power Plant. It examines issues of nuclear stewardship, and expands on Chapter 21 of Murray and Holbert.

W.S.C. Williams
Nuclear and Particle Physics
(Oxford Science Publications, 1991)
This extends content from Chapters 1 to 7 of Murray and Holbert.

Course Evaluation and Development

This course is running for the second time in 2024, and so is well-developed but not yet as refined as older courses. Thus, constructive feedback and suggestions from students are most welcome and encouraged.

One of the key priorities in the 2025 Strategy for UNSW is a drive for academic excellence in education. One of the ways of determining how well UNSW is progressing towards this goal is by listening to our own students. Students will be asked to complete the myExperience survey towards the end of this course. Students can also provide feedback during the semester via: direct contact with the lecturer, the “On-going Student Feedback” link in Moodle, and Student-Staff Liaison Committee meetings in schools.

In 2023, students returned detailed and constructive feedback in the myExperience written comments section. Three reviews of this and how to implement it were performed with the lecturer and Head of the School of Science, with the lecturer, Deputy Rector, and Associate Dean of Teaching, and by the Learning and Teaching Group. As a result, the course is moving away from a 'flipped classroom' format with pre-recorded lectures to live lectures. Assessment is being revised, with the essay format altered to reduce student and staff workload, and with marking guidelines made more specific. Further, more signposting about the structure of the course will be added, with timeline slides at the start of each lecture providing wider view of how the content develops.

Important note: Students are reminded that any feedback provided should be constructive and professional and that they are bound by the Student Code of Conduct Policy https://www.gs.unsw.edu.au/policy/documents/studentcodepolicy.pdf

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
	Paul Fraser					No	Yes