



## UNSW Course Outline

# ZEIT4014 Impact Dynamics - 2024

Published on the 11 Feb 2024

## General Course Information

Course Code : ZEIT4014

Year : 2024

Term : Semester 1

Teaching Period : Z1

Is a multi-term course? : No

Faculty : UNSW Canberra

Academic Unit : School of Engineering and Technology

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

This course explores the science of impact. It will provide the student with a thorough understanding of the mechanisms behind collisions. This will include the study of how materials deform dynamically during impacts and how the deformation is affected by geometry, material properties and the size of the impact. This course will also explore ballistic penetration and the

analytical and computational approaches that can be used to predict what happens to a material or structure during ballistic penetration. An overview of protection methodologies will be discussed including (and not limited to): ceramic armour; explosive reactive armour; concrete bunker approaches and protecting fortified structures and vehicles.

## **Course Aims**

The aim of this course will be to provide an understanding of how materials and structures respond to impact where the velocity of collisions range from tens of metres per second to many thousands of metres per second.

# Course Learning Outcomes

Course Learning Outcomes	Engineers Australia - Professional Engineer (Stage 1)
CLO1 : On successful completion of this course, the students will be able to explain the mechanisms of projectile penetration and perforation	<ul style="list-style-type: none"> <li>• PEE1.1 : Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline</li> <li>• PEE1.4 : Discernment of knowledge development and research directions within the engineering discipline</li> <li>• PEE3.2 : Effective oral and written communication in professional and lay domains</li> </ul>
CLO2 : On successful completion of this course, the students will be able to explain the nature of a broad range of materials and the mechanisms of their deformation under high strain rates.	<ul style="list-style-type: none"> <li>• PEE1.3 : In-depth understanding of specialist bodies of knowledge within the engineering discipline</li> </ul>
CLO3 : On successful completion of this course, the students will be able to show how stress waves propagate through materials and structures after a collision	<ul style="list-style-type: none"> <li>• PEE1.3 : In-depth understanding of specialist bodies of knowledge within the engineering discipline</li> </ul>
CLO4 : On successful completion of this course, the students will be able to show how computational codes can be used to study impact and penetration	<ul style="list-style-type: none"> <li>• PEE1.2 : Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline</li> <li>• PEE2.1 : Application of established engineering methods to complex engineering problem solving</li> <li>• PEE3.2 : Effective oral and written communication in professional and lay domains</li> </ul>
CLO5 : On successful completion of this course, the students will be able to explain the experimental techniques used in laboratories to probe a material's dynamic response/	<ul style="list-style-type: none"> <li>• PEE2.2 : Fluent application of engineering techniques, tools and resources</li> </ul>

Course Learning Outcomes	Assessment Item
CLO1 : On successful completion of this course, the students will be able to explain the mechanisms of projectile penetration and perforation	<ul style="list-style-type: none"> <li>• Assignment</li> <li>• A class test</li> <li>• A closed-book exam covering the learning outcomes of the course</li> </ul>
CLO2 : On successful completion of this course, the students will be able to explain the nature of a broad range of materials and the mechanisms of their deformation under high strain rates.	<ul style="list-style-type: none"> <li>• Assignment</li> <li>• A class test</li> <li>• A closed-book exam covering the learning outcomes of the course</li> </ul>
CLO3 : On successful completion of this course, the students will be able to show how stress waves propagate through materials and structures after a collision	<ul style="list-style-type: none"> <li>• An engineering report based on a computational lab</li> <li>• A class test</li> <li>• A closed-book exam covering the learning outcomes of the course</li> </ul>
CLO4 : On successful completion of this course, the students will be able to show how computational codes can be used to study impact and penetration	<ul style="list-style-type: none"> <li>• An engineering report based on a computational lab</li> <li>• A closed-book exam covering the learning outcomes of the course</li> </ul>
CLO5 : On successful completion of this course, the students will be able to explain the experimental techniques used in laboratories to probe a material's dynamic response/	<ul style="list-style-type: none"> <li>• Assignment</li> <li>• A closed-book exam covering the learning outcomes of the course</li> </ul>

## Learning and Teaching Technologies

Moodle - Learning Management System

## Learning and Teaching in this course

The course is structured around a series of lecture-style presentations and discussions on specialist topics. The course notes, which form the basis of the presentations, are supplemented by commercial and technical resource materials and relevant Standards which will be available on the MOODLE site for the course.

Reference to these resources is recommended when preparing the assignment(s) and in preparation for the examination(s). Your ability to utilize and integrate a range of technical resources in the assessment tasks will be a major criterion for superior performance in the course. Reference to these supplementary resources will greatly enhance your understanding of the various topics and develop an appreciation of the many types and formats of reference material which you may expect to be exposed to, and make use of, in your professional life.

Your active participation in the presentations is highly valued and will contribute significantly to

the overall benefit and outcomes of the course.

## The Learning Management System

Moodle is the Learning Management System used at UNSW Canberra. All courses have a Moodle site which will become available to students at least one week before the start of semester.

Please find all help and documentation (including Blackboard Collaborate) at the [Moodle Support](#) page.

UNSW Moodle supports the following web browsers:

» Google Chrome 50+

» Safari 10+

\*\* Internet Explorer is not recommended

\*\* Addons and Toolbars can affect any browser's performance.

Operating systems recommended are:

Windows 7, 10, Mac OSX Sierra, iPad IOS10

For further details about system requirements click [here](#).

Log in to Moodle [here](#).

If you need further assistance with Moodle:

For enrolment and login issues please contact:

IT Service Centre

Email: [itservicecentre@unsw.edu.au](mailto:itservicecentre@unsw.edu.au)

Phone: (02) 9385-1333

International: +61 2 9385 1333

For all other Moodle issues please contact:

External TELT Support

Email: [externalteltsupport@unsw.edu.au](mailto:externalteltsupport@unsw.edu.au)

Phone: (02) 9385-3331

International: +61 2 938 53331

Opening hours:

Monday – Friday 7:30am – 9:30 pm

Saturday & Sunday 8:30 am – 4:30pm

## Other Professional Outcomes

### Program Learning Outcomes

This course contributes to multiple programs: the Program Learning Outcomes of the Bachelor of Engineering (Hons) (Aeronautical Engineering), (Mechanical Engineering), and (Naval Architecture) and the Program Learning Outcomes of the Bachelor of Technology (Aeronautical Engineering). A complete mapping of courses to Program Learning Outcomes can be found online [here](#).

Successful completion of this course contributes to the acquisition of UNSW graduate capabilities. UNSW aspires to develop globally focused graduates who are rigorous scholars, capable of leadership and professional practice in an international community.

## Additional Course Information

### Referencing

In this course, students are required to reference following the APA 7 / Chicago NB referencing style. Information about referencing styles is available at: <https://guides.lib.unsw.adfa.edu.au/c.php?g=472948&p=3246720>

### Study at UNSW Canberra

<https://www.unsw.adfa.edu.au/study>

Study at UNSW Canberra has lots of useful information regarding:

- Where to get help
- Administrative matters
- Getting your passwords set up
- How to log on to Moodle
- Accessing the Library and other areas.

**Additional Information as required**

CRICOS Provider no. 00098G

The University of New South Wales Canberra.

# Assessments

## Assessment Structure

Assessment Item	Weight	Relevant Dates	Engineers Australia - Professional Engineer (Stage 1)
Assignment Assessment Format: Group	20%	Due Date: Week 4: 18 March - 22 March	<ul style="list-style-type: none"> <li>• PEE1.4 : Discernment of knowledge development and research directions within the engineering discipline</li> <li>• PEE1.3 : In-depth understanding of specialist bodies of knowledge within the engineering discipline</li> </ul>
An engineering report based on a computational lab Assessment Format: Individual	20%	Due Date: Week 6: 01 April - 05 April	<ul style="list-style-type: none"> <li>• PEE1.2 : Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline</li> <li>• PEE2.1 : Application of established engineering methods to complex engineering problem solving</li> <li>• PEE2.2 : Fluent application of engineering techniques, tools and resources</li> <li>• PEE3.2 : Effective oral and written communication in professional and lay domains</li> </ul>
A class test Assessment Format: Individual	20%	Due Date: Week 10: 13 May - 17 May	<ul style="list-style-type: none"> <li>• PEE1.1 : Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline</li> <li>• PEE1.3 : In-depth understanding of specialist bodies of knowledge within the engineering discipline</li> </ul>
A closed-book exam covering the learning outcomes of the course Assessment Format: Individual	40%	Due Date: Not Applicable	<ul style="list-style-type: none"> <li>• PEE1.1 : Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline</li> <li>• PEE1.3 : In-depth</li> </ul>

			understanding of specialist bodies of knowledge within the engineering discipline
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## Assessment Details

### Assignment

#### Assessment Overview

Calculation-based assignment.

#### Course Learning Outcomes

- CL01 : On successful completion of this course, the students will be able to explain the mechanisms of projectile penetration and perforation
- CL02 : On successful completion of this course, the students will be able to explain the nature of a broad range of materials and the mechanisms of their deformation under high strain rates.
- CL05 : On successful completion of this course, the students will be able to explain the experimental techniques used in laboratories to probe a material's dynamic response/

#### Detailed Assessment Description

The students in the same group will receive the same grade.

#### Hurdle rules

Each assessment at least 40%.

### An engineering report based on a computational lab

#### Course Learning Outcomes

- CL03 : On successful completion of this course, the students will be able to show how stress waves propagate through materials and structures after a collision
- CL04 : On successful completion of this course, the students will be able to show how computational codes can be used to study impact and penetration

#### Hurdle rules

40%

### A class test

#### Course Learning Outcomes

- CL01 : On successful completion of this course, the students will be able to explain the mechanisms of projectile penetration and perforation
- CL02 : On successful completion of this course, the students will be able to explain the nature of a broad range of materials and the mechanisms of their deformation under high

strain rates.

- CLO3 : On successful completion of this course, the students will be able to show how stress waves propagate through materials and structures after a collision

#### **Hurdle rules**

Each assessment at least 40%.

### **A closed-book exam covering the learning outcomes of the course**

#### **Course Learning Outcomes**

- CLO1 : On successful completion of this course, the students will be able to explain the mechanisms of projectile penetration and perforation
- CLO2 : On successful completion of this course, the students will be able to explain the nature of a broad range of materials and the mechanisms of their deformation under high strain rates.
- CLO3 : On successful completion of this course, the students will be able to show how stress waves propagate through materials and structures after a collision
- CLO4 : On successful completion of this course, the students will be able to show how computational codes can be used to study impact and penetration
- CLO5 : On successful completion of this course, the students will be able to explain the experimental techniques used in laboratories to probe a material's dynamic response/

#### **Hurdle rules**

Each assessment at least 40%.

## **General Assessment Information**

### **Assessment Requirements**

All marks obtained for assessment items during the session are provisional. The final mark as published by the university following the assessment review group meeting is the only official mark.

### **Feedback on Assessment Tasks before the Census Date**

The group assignment will be due in week 4, feedback will be given to the students during week 4.

### **Assignments**

The assignments are an opportunity for you to research and report on a topic of interest related to the course. This will enhance your understanding of the course topics, broaden your engineering competencies, and develop your skills in independent research, investigation and

report writing. Assignment 1 will be in the form of a tutorial question and will be a group-based assignment and Assignment 2 will be in the form of a report (individual submission). Both are to be submitted via Moodle.

### **Late Submission of Assessment**

Unless prior arrangement is made with the lecturer or a formal application for special consideration is submitted, a penalty of 5% of the total available mark for the assessment will apply for each day that an assessment item is late up to a maximum of 5 days (120 hours) after which an assessment can no longer be submitted and a grade of 0 will be applied.

### **Use of Generative AI in Assessments**

#### **SIMPLE EDITING ASSISTANCE**

For the report assessment task, you may use standard editing and referencing software, but not Generative AI. You are permitted to use the full capabilities of the standard software to answer the question (e.g. you may wish to specify particular software such as Microsoft Office suite, Grammarly, etc.).

If the use of generative AI such as ChatGPT is detected, it will be regarded as serious academic misconduct and subject to the standard penalties, which may include 00FL, suspension and exclusion.

### **Grading Basis**

Standard

### **Requirements to pass course**

Each assessment at least 40% & Final mark at least 50%

# Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 26 February - 1 March	Lecture	Penetration mechanics (Hongxu Wang)
Week 2 : 4 March - 8 March	Lecture	Penetration mechanics (Hongxu Wang)
Week 3 : 11 March - 15 March	Lecture	Penetration mechanics (Hongxu Wang)
Week 4 : 18 March - 22 March	Assessment	Assignment (Group)
	Lecture	Computational mechanics (Hongxu Wang)
Week 5 : 25 March - 29 March	Lecture	Computational mechanics (Hongxu Wang)
Week 6 : 1 April - 5 April	Lecture	Stress waves (Hongxu Wang)
	Assessment	Report (Individual)
Week 7 : 22 April - 26 April	Lecture	Shock waves (Paul Hazell) No lectures on Wednesday (Military Training Day)
Week 8 : 29 April - 3 May	Lecture	Shock waves (Paul Hazell)
Week 9 : 6 May - 10 May	Lecture	Shock waves - spall & Ammunition (Paul Hazell)
Week 10 : 13 May - 17 May	Lecture	Protection methodologies (Hongxu Wang)
	Assessment	In-class quiz
Week 11 : 20 May - 24 May	Lecture	Experimental techniques (Hongxu Wang)
	Laboratory	Lab demonstration (Hongxu Wang & Jianshen Wang)
Week 12 : 27 May - 31 May	Lecture	Impact of composites (Hongxu Wang) No lectures on Tuesday (Compensation Day – Monday Timetable)
Week 13 : 3 June - 7 June	Lecture	Seminar - TBC & Review

## Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings.

## General Schedule Information

No lectures on Wednesday in Week 7 (Military Training Day)

No lectures on Tuesday in Week 12 (Compensation Day – Monday Timetable)

## Course Resources

### Prescribed Resources

- Hazell, PJ: Armour: Materials, Theory, and Design, 2Ed, CRC Press (2022), ISBN: 978-0367419714.

# Recommended Resources

- Doig A, Military Metallurgy, Maney Publishing, Institute of Materials, 2002.
- Carlucci, D.E., Jacobson, S. S., Ballistics: Theory and Design of Guns and Ammunition, CRC Press (2007), ISBN: 9 781420066 197.
- Rosenberg, Z and Dekel, E: Terminal ballistics, Springer (2012), ISBN: 3 642253 040.
- Meyers, MA: Dynamic behaviour of materials, Wiley (1994), ISBN: 9 780471582 625.

# Course Evaluation and Development

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 “Ongoing Student Feedback” link in Moodle, Student-Staff Liaison Committee meetings in schools, informal feedback conducted by staff, and focus groups. Student opinions really do make a difference. Refer to the Moodle site for this course to see how the feedback from previous students has contributed to the course development.

**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.

# Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	Hongxu Wang		Room 227, Building 16, UNSW Canberra	02 5114 5217	Consultation at any time in working hours. Appointment by email preferred to avoid clashes.	No	Yes
Lecturer	Paul Hazel I		Room G01, Building 26, UNSW Canberra	02 5114 5156	Consultation at any time in working hours. Appointment by email preferred to avoid clashes.	No	No

# Other Useful Information

## Academic Information

## Course Evaluation and Development

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 each course.

Students can also provide feedback during the semester via: direct contact with the lecturer, the “On-going Student Feedback” link in Moodle, Student-Staff Liaison Committee meetings in schools, informal feedback conducted by staff, and focus groups (where applicable). Student opinions really do make a difference. Refer to the Moodle site for your course to see how the feedback from previous students has contributed to the course development.

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.

<https://www.gs.unsw.edu.au/policy/documents/studentcodepolicy.pdf>

## **Equitable Learning Services (ELS)**

Students living with neurodivergent, physical and/or mental health conditions or caring for someone with these conditions may be eligible for support through the Equitable Learning Services team. Equitable Learning Services is a free and confidential service that provides practical support to ensure your mental or physical health conditions do not adversely affect your studies.

Our team of dedicated **Equitable Learning Facilitators (ELFs)** are here to assist you through this process. We offer a number of services to make your education at UNSW easier and more equitable.

Further information about ELS for currently enrolled students can be found at: <https://www.student.unsw.edu.au/equitable-learning>

## **Academic Honesty and Plagiarism**

UNSW has an ongoing commitment to fostering a culture of learning informed by academic integrity. All UNSW staff and students have a responsibility to adhere to this principle of academic integrity. All students are expected to adhere to UNSW’s Student Code of Conduct. Find relevant information at: [Student Code of Conduct \(unsw.edu.au\)](https://www.unsw.edu.au/student-code-of-conduct)

Plagiarism undermines academic integrity and is not tolerated at UNSW. It is defined as using

the words or ideas of others and passing them off as your own, and can take many forms, from deliberate cheating to accidental copying from a source without acknowledgement.

For more information, please refer to the following:

<https://student.unsw.edu.au/plagiarism>

## Submission of Assessment Tasks

### Special Consideration

Special Consideration is the process for assessing and addressing the impact on students of short-term events, that are beyond the control of the student, and that affect performance in a specific assessment task or tasks.

Applications for Special Consideration will be accepted in the following circumstances only:

- Where academic work has been hampered to a substantial degree by illness or other cause;
- The circumstances are unexpected and beyond the student's control;
- The circumstances could not have reasonably been anticipated, avoided or guarded against by the student; and either:

(i) they occurred during a critical study period and was 3 consecutive days or more duration, or a total of 5 days within the critical study period; or

(ii) they prevented the ability to complete, attend or submit an assessment task for a specific date (e.g. final exam, in class test/quiz, in class presentation)

Applications for Special Consideration must be made as soon as practicable after the problem occurs and at the latest within three working days of the assessment or the period covered by the supporting documentation.

By sitting or submitting the assessment task the student is declaring that they are fit to do so and cannot later apply for Special Consideration (UNSW 'fit to sit or submit' requirement).

Sitting, accessing or submitting an assessment task on the scheduled assessment date, after applying for special consideration, renders the special consideration application void.

Find more information about special consideration at: <https://www.student.unsw.edu.au/special/consideration/guide>

Or apply for special consideration through your [MyUNSW portal](#).

### **Late Submission of assessment tasks (other than examinations)**

UNSW has a standard late submission penalty of:

- 5% per day,
- capped at five days (120 hours) from the assessment deadline, after which a student cannot submit an assessment, and
- no permitted variation.

Students are expected to manage their time to meet deadlines and to request extensions as early as possible before the deadline.

### **Electronic submission of assessment**

Except where the nature of an assessment task precludes its electronic submission, all assessments must be submitted to an electronic repository, approved by UNSW or the Faculty, for archiving and subsequent marking and analysis.

### **Release of final mark**

All marks obtained for assessment items during the session are provisional. The final mark as published by the university following the assessment review group meeting is the only official mark.