UNSW Course Outline

# ZEIT4013 Hypersonics and Advanced Propulsion - 2024

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## General Course Information

**Course Code :** ZEIT4013
**Year :** 2024
**Term :** Semester 2
**Teaching Period :** Z2
**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

ZEIT4013 is a 6 Unit of Credit elective course that introduces students to the fundamental physical problems of hypersonic flight and hypersonic testing, as well as touching on the scientific, tactical, strategic, political, and societal aspects of hypersonic technologies. The

course is entirely project-based and will see students investigate a chosen hypersonic system and carry that system through a variety of projects, culminating in the design of a ground test facility suitable for that system.

The projects include two presentations, one on the background on the system and one on a hypersonic ground testing facility. Presentation skills make up a significant portion of the marks for those assessments.  Another project is designed for students to learn and apply the fundamental physical principles of hypersonic flight, including but not limited to, analysis of shocks and expansions, boundary layers, high-temperature effects and heating, and rarefied gas effects.  The final project will be a group project to design a hypersonic ground test facility for the chosen system.

The course follows on from the third-year aerodynamics course ZEIT3503 with some knowledge of compressible flow assumed. The course also assumes that the students have a preliminary knowledge of fluid mechanical principles, acquired in the two second-year core fluids courses for aeronautical and mechanical engineers, ZEIT2500 and ZEIT2503.  It is important for students to remember the Navier-Stokes equations from second- and third-year fluids courses, as these are fundamental to explaining the behaviour of hypersonic flows.

## Course Aims

Through the projects in this course, students should gain not only experience with the calculation of hypersonic physics problems, but a broader understanding of the physical, scientific, testing, societal, and cultural implications of hypersonic technologies.  The course aims to provide students with practical skills in analytically and computationally predicting important behaviours of hypersonic flows, and to provide a quantitative understanding of current hypersonics-related technologies such as atmospheric entry, computation of rarefied flows, analytical modelling of inviscid and viscous flows, nonequilibrium processes in hypersonic flows and supersonic combustion propulsion systems.

## Relationship to Other Courses

This is an elective in the Aeronautical Engineering degree.  It assumes knowledge from ZEIT 2502 Fundamentals of Flight and ZEIT 3503 Aerodynamics. The prerequisite courses are ZEIT 2500 Thermofluids and ZEIT 2503 Fluid Mechanics.

# Course Learning Outcomes

| Course Learning Outcomes | Engineers Australia - Professional Engineer (Stage 1) |
|---|---|
| CLO1 : Assess the technological, scientific, societal, political, tactical, and strategic characteristics of hypersonic vehicle systems and ground testing facilities and synthesize that information for an audience. | • PEE1.5 : Knowledge of engineering design practice and contextual factors impacting the engineering discipline<br>• PEE1.6 : Understanding of the scope, principles, norms, accountabilities and bounds of sustainable engineering practice in the specific discipline<br>• PEE3.1 : Ethical conduct and professional accountability |
| CLO2 : Analyse a hypersonic vehicle system in terms of the fundamental physical challenges involved in hypersonic flight, including (but not limited to) the analysis of shocks and expansions, boundary layers, high-temperature effects and heating, and rarefied gas effects. | • PEE1.1 : Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline<br>• PEE1.3 : In-depth understanding of specialist bodies of knowledge within the engineering discipline<br>• PEE1.5 : Knowledge of engineering design practice and contextual factors impacting the engineering discipline<br>• PEE2.1 : Application of established engineering methods to complex engineering problem solving<br>• PEE2.2 : Fluent application of engineering techniques, tools and resources<br>• PEE2.3 : Application of systematic engineering synthesis and design processes |
| CLO3 : Estimate the impact of the integration of a hypersonic airbreathing propulsion system onto a hypersonic vehicle system and compare qualitatively and quantitatively with other propulsion options. | • PEE1.1 : Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline<br>• PEE1.2 : Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline<br>• PEE1.3 : In-depth understanding of specialist bodies of knowledge within the engineering discipline<br>• PEE2.1 : Application of established engineering methods to complex engineering problem solving<br>• PEE2.2 : Fluent application of engineering techniques, tools and resources<br>• PEE2.3 : Application of systematic engineering synthesis and design processes |
| CLO4 : Design a hypersonic ground testing facility suitable for testing a hypersonic | • PEE1.1 : Comprehensive, theory based understanding of the underpinning natural and |

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| vehicle system, and identify the limitations and challenges associated with that facility. | physical sciences and the engineering fundamentals applicable to the engineering discipline<br>• PEE1.2 : Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline<br>• PEE1.3 : In-depth understanding of specialist bodies of knowledge within the engineering discipline<br>• PEE1.5 : Knowledge of engineering design practice and contextual factors impacting the engineering discipline<br>• PEE2.2 : Fluent application of engineering techniques, tools and resources<br>• PEE2.3 : Application of systematic engineering synthesis and design processes<br>• PEE3.3 : Creative, innovative and pro-active demeanour<br>• PEE3.4 : Professional use and management of information<br>• PEE3.6 : Effective team membership and team leadership |
| CLO5 : Produce and present oral presentations, posters, technical reports, and/ or design portfolios suitable for professional presentation to an audience. | • PEE1.6 : Understanding of the scope, principles, norms, accountabilities and bounds of sustainable engineering practice in the specific discipline<br>• PEE3.2 : Effective oral and written communication in professional and lay domains<br>• PEE3.4 : Professional use and management of information<br>• PEE3.5 : Orderly management of self, and professional conduct |

| Course Learning Outcomes | Assessment Item |
|---|---|
| CLO1 : Assess the technological, scientific, societal, political, tactical, and strategic characteristics of hypersonic vehicle systems and ground testing facilities and synthesize that information for an audience. | • Presentations<br>• Hypersonic Flow Assignment<br>• Hypersonic Propulsion Assignment<br>• Final Group Project |
| CLO2 : Analyse a hypersonic vehicle system in terms of the fundamental physical challenges involved in hypersonic flight, including (but not limited to) the analysis of shocks and expansions, boundary layers, high-temperature effects and heating, and rarefied gas effects. | • Hypersonic Flow Assignment<br>• Hypersonic Propulsion Assignment |
| CLO3 : Estimate the impact of the integration of a hypersonic airbreathing propulsion system onto a hypersonic vehicle system and compare qualitatively and quantitatively with other propulsion options. | • Hypersonic Propulsion Assignment |
| CLO4 : Design a hypersonic ground testing facility suitable for testing a hypersonic vehicle system, and identify the limitations and challenges associated with that facility. | • Presentations<br>• Final Group Project |
| CLO5 : Produce and present oral presentations, posters, technical reports, and/or design portfolios suitable for professional presentation to an audience. | • Presentations<br>• Final Group Project |

# Learning and Teaching Technologies

Moodle - Learning Management System

# Learning and Teaching in this course

This course is designed as a fully project-based course with additional optional work offered to reach the D/HD levels of achievement.  Students will select a hypersonic system of their choice to analyse during the semester, and then design a wind-tunnel facility to test it.  Lectures will introduce the essential physics of hypersonics and tuturials are used to assist the students in completing their projects.

**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
Phone: (02) 9385-1333
International: +61 2 9385 1333

For all other Moodle issues please contact:
External TELT Support
Email: 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

# Additional Course Information

**Academic Integrity 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 https://www.gs.unsw.edu.au/policy/documents/studentcodepolicy.pdf

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

**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) |
|---|---|---|---|
| Presentations<br>Assessment<br>Format: Individual | 20% | Start Date: Not Applicable<br>Due Date: Not Applicable | • PEE1.3 : In-depth understanding of specialist bodies of knowledge within the engineering discipline<br>• PEE1.5 : Knowledge of engineering design practice and contextual factors impacting the engineering discipline<br>• PEE1.6 : Understanding of the scope, principles, norms, accountabilities and bounds of sustainable engineering practice in the specific discipline<br>• PEE2.3 : Application of systematic engineering synthesis and design processes<br>• PEE3.2 : Effective oral and written communication in professional and lay domains<br>• PEE3.5 : Orderly management of self, and professional conduct<br>• PEE3.4 : Professional use and management of information |
| Hypersonic Flow Assignment<br>Assessment<br>Format: Individual<br>Short Extension: Yes (7 days) | 40% | Due Date: 13/09/2024 11:59 PM | • PEE1.1 : Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline<br>• PEE1.3 : In-depth understanding of specialist bodies of knowledge within the engineering discipline<br>• PEE1.5 : Knowledge of engineering design practice and contextual factors impacting the engineering discipline |

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| | | | • PEE1.2 : Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline<br>• PEE2.1 : Application of established engineering methods to complex engineering problem solving<br>• PEE2.2 : Fluent application of engineering techniques, tools and resources<br>• PEE2.3 : Application of systematic engineering synthesis and design processes<br>• PEE3.3 : Creative, innovative and pro-active demeanour |
| Hypersonic Propulsion Assignment<br>Assessment Format: Individual<br>Short Extension: Yes (5 days) | 10% | Due Date: 04/10/2024 11:59 PM | • PEE1.1 : Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline<br>• PEE1.2 : Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline<br>• PEE1.3 : In-depth understanding of specialist bodies of knowledge within the engineering discipline<br>• PEE2.1 : Application of established engineering methods to complex engineering problem solving<br>• PEE2.2 : Fluent application of engineering techniques, tools and resources<br>• PEE2.3 : Application of systematic engineering synthesis and design processes<br>• PEE3.2 : Effective oral and written communication in professional and lay |

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| | | | domains<br>• PEE3.4 : Professional use and management of information<br>• PEE3.3 : Creative, innovative and pro-active demeanour<br>• PEE3.5 : Orderly management of self, and professional conduct |
| Final Group Project<br>Assessment Format: Group | 30% | Start Date: Not Applicable<br>Due Date: 06/11/2024 11:59 PM | • PEE1.1 : Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline<br>• PEE1.2 : Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline<br>• PEE1.3 : In-depth understanding of specialist bodies of knowledge within the engineering discipline<br>• PEE1.5 : Knowledge of engineering design practice and contextual factors impacting the engineering discipline<br>• PEE2.1 : Application of established engineering methods to complex engineering problem solving<br>• PEE2.2 : Fluent application of engineering techniques, tools and resources<br>• PEE2.3 : Application of systematic engineering synthesis and design processes<br>• PEE2.4 : Application of systematic approaches to the conduct and management of projects within the technology domain<br>• PEE3.3 : Creative, innovative and pro-active demeanour |

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| | | | • PEE3.5 : Orderly management of self, and professional conduct<br>• PEE3.6 : Effective team membership and team leadership |

# Assessment Details

## Presentations

**Assessment Overview**

- Presentation 1, due week 4.  Hypersonic System Selection, Characterisation, and Presentation - 10%
- Presentation 2, due week 11.  Ground Test Facility Presentation - 10%

**Course Learning Outcomes**

- CLO1 : Assess the technological, scientific, societal, political, tactical, and strategic characteristics of hypersonic vehicle systems and ground testing facilities and synthesize that information for an audience.
- CLO4 : Design a hypersonic ground testing facility suitable for testing a hypersonic vehicle system, and identify the limitations and challenges associated with that facility.
- CLO5 : Produce and present oral presentations, posters, technical reports, and/or design portfolios suitable for professional presentation to an audience.

**Detailed Assessment Description**

There are two presentations as part of this course, one on a hypersonic system and one on a ground test facility.

The hypersonic systems presentations will be presented during Week 3 of the course during both lecture and tutorial time.

**Early Feedback Before Census Date**

Assignment 1 (Presentation) will be held in week 3, feedback, grades and comments will be given to students both immediately during / after the presentation and written comments will be provided during week 4.

The ground test facility presentations will be presented at the end of week 9 and the beginning of week 10 during both lecture and tutorial time.

Note that both of these timings may vary slightly at the discretion of the course staff.

Hypersonic Systems Presentation overview:

Each student will choose a hypersonic weapons system (or civilian system with approval) and become an ``expert'' about the all aspects of the system.  This system will form the basis of all of the individual projects this semester, and may be the one selected for the final group project. Students will gain an understanding of the challenges associated with hypersonic systems both through the execution of their own projects and they presentations by their fellow students.

Ground Test Facility Presentation overview:

Each student will use their previously chosen hypersonic system and select a trajectory point. Using this, the student will then need to conduct a survey of ground test facilities and choose the facility they think would best accommodate their vehicle. In doing so, the student should become an ``expert'' about all aspects of this facility, as they will be presenting their choice to their fellow students. These presentations should form a basis for the cohort as a collective assay, which will assist in the final project.

**Use of Generative AI in Assessment**

*SIMPLE EDITING ASSISTANCE*

*For this 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.*

**Assignment submission Turnitin type**

This is not a Turnitin assignment

## Hypersonic Flow Assignment

**Assessment Overview**

- Assignment 1 - First two topics - 20%
- Assignment 2 - Second two topics - 20%

Course Learning Outcomes

- CLO1 : Assess the technological, scientific, societal, political, tactical, and strategic characteristics of hypersonic vehicle systems and ground testing facilities and synthesize that information for an audience.
- CLO2 : Analyse a hypersonic vehicle system in terms of the fundamental physical challenges involved in hypersonic flight, including (but not limited to) the analysis of shocks and expansions, boundary layers, high-temperature effects and heating, and rarefied gas effects.

Detailed Assessment Description

**NOTE:** Even though this is split into two parts, there is only one due date and turnin.

You are expected to be able to analyse a hypersonic vehicle system in terms of the fundamental physical challenges involved in hypersonic flight including (but not limited to) the analysis of shocks and expansions, boundary layers, high-temperature effects and heating, and rarefied gas effects to your specific hypersonic systems.

Pick a design point in your system from assignment 1 in terms of flight conditions and/or component of interest (e.g. configuration, inlet, nozzle, etc.) then identify, discuss, and analyse it in terms of:

Part I

Viscous & inviscid interactions.
Shock-wave/boundary layer interactions.
Boundary layer transition.

Part II
High-temperature effects.
Rarefied effects.
Bluntness and angle of attack effects.

Use of Generative AI in Assessments

*SIMPLE EDITING ASSISTANCE*

*For this 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.*

Assignment submission Turnitin type

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

## Hypersonic Propulsion Assignment

Assessment Overview

Propulsion integration assignment

Course Learning Outcomes

- CLO1 : Assess the technological, scientific, societal, political, tactical, and strategic characteristics of hypersonic vehicle systems and ground testing facilities and synthesize that information for an audience.
- CLO2 : Analyse a hypersonic vehicle system in terms of the fundamental physical challenges involved in hypersonic flight, including (but not limited to) the analysis of shocks and expansions, boundary layers, high-temperature effects and heating, and rarefied gas effects.
- CLO3 : Estimate the impact of the integration of a hypersonic airbreathing propulsion system onto a hypersonic vehicle system and compare qualitatively and quantitatively with other propulsion options.

Detailed Assessment Description

Each student will undertake a guided analysis of a hypersonic scramjet propulsion system and submit their findings digitally in the form of an academic style A3 poster. Students will gain an understanding of the mechanisms and challenges of hypersonic propulsion, scramjet systems, and develop their visual communication skills.

### Use of Generative AI in Assessment

*SIMPLE EDITING ASSISTANCE*

*For this 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.*

## Final Group Project

**Assessment Overview**

Ground Test Facility Design.

**Course Learning Outcomes**

- CLO1 : Assess the technological, scientific, societal, political, tactical, and strategic characteristics of hypersonic vehicle systems and ground testing facilities and synthesize that information for an audience.
- CLO4 : Design a hypersonic ground testing facility suitable for testing a hypersonic vehicle system, and identify the limitations and challenges associated with that facility.
- CLO5 : Produce and present oral presentations, posters, technical reports, and/or design portfolios suitable for professional presentation to an audience.

**Detailed Assessment Description**

Marking - ALL GROUP MEMBERS will recieve the same grade for this project, unless extenuating circumstances exist and have been worked out in advance with the course convenor. See the detailed marking rubrics on Moodle for more detail.

In this group assignment, you will synthesize all you have learned about both the hypersonic system your group has chosen and what you have learned about hypersonic ground testing facilities to design a bespoke facility for your system. You will do this in the following steps:

- Determine a physical problem of interest that is specifically applicable to your system

- Determine the flight conditions for that issue, and select the type of ground test facility that you will design

- Design an experiment that can address the problem that you've identified

- Design a tunnel geometry and associated systems to test that experiement

- Design a diagnostic system that can gather the information needed to answer your physical problem on interest

- Optionally (depending on number of students and desire mark) design additional diagnostics, generate CAD models, or perform CFD simulations of your tunnel / experiment

**Use of Generative AI in Assessment**

*PLANNING ASSISTANCE*

*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 final submission. It is a good idea to keep copies of the initial prompts to show your lecturer if there is any uncertainty about the originality of your work. [Alternative wording: You are required to submit the original AI generated responses as set out below] (Consider what would be the minimum requirement for you to be satisfied of the originality of the submitted work, and the workload implications of any detailed examination as part of the marking).*

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

Assignment submission Turnitin type

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

# General Assessment Information

### Early Feedback Before Census Date

Assignment 1 (Presentation) will be held in week 3, feedback, grades and comments will be given to students both immediately during / after the presentation and written comments will be provided during week 4.

### 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

*This varies by assessment type.  Please see the individual assessment tasks for detials.*

Grading Basis

Standard

Requirements to pass course

In order to pass the course, student must achieve at least a mark of 50 out of 100 for the course.

# Course Schedule

| Teaching Week/Module | Activity Type | Content |
|---|---|---|
| Week 1 : 15 July - 19 July | Lecture | Introduction, Hypersonic Problems |
| | Lecture | Types of Hypersonic Vehicles |
| | Tutorial | Selection of hypersonic systems and approval from course staff |
| Week 2 : 22 July - 26 July | Lecture | Inviscid Flow 1 |
| | Lecture | Inviscid Flow 2 |
| | Tutorial | Inviscid Flow |
| Week 3 : 29 July - 2 August | Lecture | Student Presentations |
| | Lecture | Student Presentations |
| | Tutorial | Student Presentations |
| Week 4 : 5 August - 9 August | Lecture | Viscous Flow 1 |
| | Lecture | Viscous Flow 2 |
| | Tutorial | Viscous Flow |
| Week 5 : 12 August - 16 August | Lecture | HIgh Temperature Effects |
| | Lecture | Rarefied Flows |
| | Tutorial | High temperature effects and rarefied flows |
| Week 6 : 19 August - 23 August | Tutorial | NOTE: Tutorial is on Tuesday this week due to miltiary training day. Tutorial will cover physics issues. |
| | Lecture | CFD Challenges |
| | Lecture | Ground Testing 1 |
| Week 7 : 9 September - 13 September | Lecture | Ground Testing II |
| | Lecture | Guest Lecture: Professor Andrew Neely |
| | Tutorial | Tutorial - Ground Testing |
| Week 8 : 16 September - 20 September | Lecture | Wednesday lecture canceled due to military training day. |
| | Lecture | Hypersonic Propulsion 1 |
| | Tutorial | Hypersonic Propulsion |
| Week 9 : 23 September - 27 September | Lecture | Scramjets |
| | Lecture | Student Presentations |
| | Tutorial | Student Presentations |
| Week 10 : 30 September - 4 October | Lecture | Student Presentations |
| | Lecture | Special Topic 1: Countermeasures 1 |
| | Tutorial | Propulsion Project |
| Week 11 : 7 October - 11 October | Lecture | Special Topic: Countermeasure OR Hypersonic Materials |
| | Lecture | Thursday lecture canceled due to military training day |
| | Tutorial | Friday tutorial canceled due to military training day |
| Week 12 : 14 October - 18 October | Lecture | Special Topic: FSI |
| | Lecture | Special Topic: Hypersonic Design |
| | Tutorial | Final Group Projects |
| Week 13 : 21 October - 25 October | Lecture | Special Topic or group work |
| | Lecture | Special Topic or group work |
| | Tutorial | Final group project |

## Attendance Requirements

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

## General Schedule Information

Military Training Day: Friday 18 August.  Compensation Day: Friday 16 August classes to be delivered on Tuesday 13 August. Tuesday 13 August lost.

Military Training Day: Wednesday 18 September.  Wednesday Lost

Labour Day: Monday 7 October.  Monday Lost

Military Training Day: Thursday, 10 October.  Thursday Lost

Military Training Day: Friday, 11 October.  Friday Lost

# Course Resources

## Prescribed Resources

Anderson, J. D. (1989). *Hypersonic and high temperature gas dynamics*. 3rd Edition, AIAA.  ISBN 978-1-62410-514-2

Maurice Rasmussen, "Hypersonic Flow." 1st Edition, Wiley-Interscience. ISBN 978-0471511021

## Recommended Resources

Chanetz, B., Délery, J., Gilliéron, P., Gnemmi, P., Gowree, E. R., & Perrier, P. (2020). *Experimental Aerodynamics*. Springer International Publishing.

Hirschel, E. H., & Weiland, C. (2009). *Selected aerothermodynamic design problems of hypersonic flight vehicles* (Vol. 229). Springer Science & Business Media.

Murthy, S.N.B and Curran, E.T (2001).  Scramjet Propulsion. AIAA.  ISBN 978-1-56347-322-7

Babinsky, H., & Harvey, J. K. (Eds.). (2011). *Shock wave-boundary-layer interactions* (Vol. 32). Cambridge University Press.

Bird, G. A. (1994). *Molecular gas dynamics and the direct simulation of gas flows*. Oxford university press.

## Course Evaluation and Development

This course is being completely redeveloped this year, both in response to student feedback and to the departure of the previous lecturer. This course has been wholly reimagined as a completely project-based course. This course will utilize a mid-semester survey as well as ongoing interactions between the teaching staff with the students to evaluate and improve the student learning experience.

In previous years, this course was very coding heavy with a particular emphasis on the simulation of rarefied flows. This course has been changed to mirror the topics in the highly successful hypersonics course at the U.S. Air Force Academy, as well as integrating a project-based assessment throughout the semester.

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, 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

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

# Staff Details

| Position | Name | Email | Location | Phone | Availability | Equitable Learning Services Contact | Primary Contact |
|---|---|---|---|---|---|---|---|
| Convenor | Charles Hoke | | Remote - Convenor Only (non-lecturing) | By email only | By email only. Can be available for teams chat by appointment only. | Yes | No |
| Tutor | Luke Pollock | | B20 G03 | +61487330512 | Monday 1130 - 1230. Otherwise by appointment only. | No | No |
| Head lecturer | Amna Khraibut | | B20 G02 | +61431814193 | Tuesday 13:00-14:00 & Thursday 10:00-11:00. Otherwise by appointment only. | No | Yes |
| Lecturer | Dylan Dooner | | | | | No | No |