UNSW Course Outline

ZEIT8513 Rocket Motors, Propellants, and Pyrotechnics - 2024

Published on the 19 Jul 2024

General Course Information

Course Code : ZEIT8513
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 : Online
Delivery Format : Standard
Delivery Location : UNSW Canberra at ADFA
Campus : UNSW Canberra
Study Level : Postgraduate
Units of Credit : 6

Useful Links

Handbook Class Timetable

Course Details & Outcomes

Course Description

This course aims to develop a critical understanding of the principles, properties, composition

and combustion kinetics of propellants and pyrotechnics, and their application in gun systems, rocket motors, countermeasures, special effects, screening/signalling and other applications. The differences between liquid, solid and gel propellants will be discussed as they relate to rocket systems and gun systems as well as looking at emerging manufacturing trends.

Enrolment in this course is only available to students nominated by the Department of Defence.

Course Aims

The aim of this course is to develop an understanding of the principles, composition and combustion kinetics of pyrotechnics and propellants, and their application in gun systems, rocket motors, counter measures, special effects, screening/signalling and other common applications.

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Demonstrate an understanding of the chemistry, form, properties and combustion kinetics of propellants and pyrotechnics.
CLO2 : Demonstrate a critical awareness of the vulnerability of propellant and pyrotechnic systems in relation to applied stimuli and the challenges associated with storage.
CLO3 : Describe the modes of failure of propellant-based and pyrotechnic-based systems.
CLO4 : Describe rocket motor design, manufacture, and mechanisms of propulsion.
CLO5 : Demonstrate a critical awareness of the latest developments in gun and rocket propellants and pyrotechnic formulations in relation to solid, liquid and gelled compositions.

Course Learning Outcomes	Assessment Item
CLO1 : Demonstrate an understanding of the chemistry, form, properties and combustion kinetics of propellants and pyrotechnics.	• Capstone Assignment ZEIT8513 • Online Quiz 3 • Online Quiz 1
CLO2 : Demonstrate a critical awareness of the vulnerability of propellant and pyrotechnic systems in relation to applied stimuli and the challenges associated with storage.	• Capstone Assignment ZEIT8513 • Online Quiz 3 • Online Quiz 1
CLO3 : Describe the modes of failure of propellant-based and pyrotechnic-based systems.	• Online Quiz 2 • Capstone Assignment ZEIT8513 • Online Quiz 3
CLO4 : Describe rocket motor design, manufacture, and mechanisms of propulsion.	• Online Quiz 2 • Capstone Assignment ZEIT8513 • Online Quiz 3
CLO5 : Demonstrate a critical awareness of the latest developments in gun and rocket propellants and pyrotechnic formulations in relation to solid, liquid and gelled compositions.	• Capstone Assignment ZEIT8513 • Online Quiz 3

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. Some content will be available online including pre-recorded content. The course notes, which form the basis of the presentations, are supplemented by commercial and technical resource materials which will be available on the MOODLE site for the course.

Reference to these resources is recommended 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
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
Capstone Assignment ZEIT8513 Assessment Format: Individual	40%	Start Date: Not Applicable Due Date: 01/11/2024 11:59 PM
Online Quiz 3 Assessment Format: Individual Short Extension: Yes (7 days)	20%	Start Date: 15/09/2024 12:00 AM Due Date: 23/09/2024 12:00 AM
Online Quiz 2 Assessment Format: Individual Short Extension: Yes (7 days)	20%	Start Date: 11/08/2024 12:00 AM Due Date: 18/08/2024 12:00 AM
Online Quiz 1 Assessment Format: Individual Short Extension: Yes (7 days)	20%	Start Date: 22/07/2024 12:00 AM Due Date: 29/07/2024 12:00 AM

Assessment Details

Capstone Assignment ZEIT8513

Assessment Overview

An opportunity to showcase your learning in a real-world setting.

Course Learning Outcomes

- CLO1 : Demonstrate an understanding of the chemistry, form, properties and combustion kinetics of propellants and pyrotechnics.
- CLO2 : Demonstrate a critical awareness of the vulnerability of propellant and pyrotechnic systems in relation to applied stimuli and the challenges associated with storage.
- CLO3 : Describe the modes of failure of propellant-based and pyrotechnic-based systems.
- CLO4 : Describe rocket motor design, manufacture, and mechanisms of propulsion.
- CLO5 : Demonstrate a critical awareness of the latest developments in gun and rocket propellants and pyrotechnic formulations in relation to solid, liquid and gelled compositions.

Detailed Assessment Description

The use of generative AI is expressly prohibited.

Assessment Length

7500 words

Assignment submission Turnitin type

This assignment is submitted through Turnitin and students do not see Turnitin similarity reports.

Generative AI Permission Level

No Assistance

This assessment is designed for you to complete without the use of any generative AI. You are not permitted to use any generative AI tools, software or service to search for or generate information or answers.
For more information on Generative AI and permitted use please see here.

THE USE OF AI IS EXPRESSLY PROHIBITED DUE TO THE NATURE OF OUR WORK

Online Quiz 3

Assessment Overview

A test of your progress to date within the course.

Course Learning Outcomes

- CLO1 : Demonstrate an understanding of the chemistry, form, properties and combustion kinetics of propellants and pyrotechnics.
- CLO2 : Demonstrate a critical awareness of the vulnerability of propellant and pyrotechnic systems in relation to applied stimuli and the challenges associated with storage.
- CLO3 : Describe the modes of failure of propellant-based and pyrotechnic-based systems.
- CLO4 : Describe rocket motor design, manufacture, and mechanisms of propulsion.
- CLO5 : Demonstrate a critical awareness of the latest developments in gun and rocket propellants and pyrotechnic formulations in relation to solid, liquid and gelled compositions.

Detailed Assessment Description

Quiz 3

Assessment Length

Short exam

Assignment submission Turnitin type

Not Applicable

Generative AI Permission Level

No Assistance

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The use of generative AI is expressly prohibited due to the nature of our work

Online Quiz 2

Assessment Overview

A test of your ability to describe the modes of failure of propellant-based and pyrotechnic-based systems and to describe rocket motor design, manufacture, and mechanisms of propulsion.

Course Learning Outcomes

- CLO3 : Describe the modes of failure of propellant-based and pyrotechnic-based systems.
- CLO4 : Describe rocket motor design, manufacture, and mechanisms of propulsion.

Detailed Assessment Description

Quiz 2

Assessment Length

Short answer

Assignment submission Turnitin type

Not Applicable

Generative AI Permission Level

No Assistance

This assessment is designed for you to complete without the use of any generative AI. You are not permitted to use any generative AI tools, software or service to search for or generate information or answers.
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The use of generative AI is expressly prohibited due to the nature of our work

Online Quiz 1

Assessment Overview

Test of your understanding of the chemistry, form, properties and combustion kinetics of propellants and pyrotechnics and your critical awareness of the vulnerability of propellant and pyrotechnic systems in relation to applied stimuli and the challenges associated with storage.

Course Learning Outcomes

- CLO1 : Demonstrate an understanding of the chemistry, form, properties and combustion kinetics of propellants and pyrotechnics.
- CLO2 : Demonstrate a critical awareness of the vulnerability of propellant and pyrotechnic systems in relation to applied stimuli and the challenges associated with storage.

Detailed Assessment Description

Quiz 1

Assignment submission Turnitin type

Not Applicable

Generative AI Permission Level

No Assistance

This assessment is designed for you to complete without the use of any generative AI. You are not permitted to use any generative AI tools, software or service to search for or generate information or answers.
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General Assessment Information

Written feedback on the online quiz will be provided before the census date (11 August)

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

The use of Generative AI is expressly prohibited. 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.

Grading Basis

Standard

Requirements to pass course

Completion of all assessment items with greater than 50% overall mark

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 15 July - 19 July	Lecture	Introduction to energetic materials: propellants, explosives and pyrotechnics Solid Rocket Motors, Hybrid and Liquid Rocket Engines
Week 2 : 22 July - 26 July	Lecture	The chemistry of propellants and pyrotechnics The mechanics of rocket propulsion
Week 3 : 29 July - 2 August	Lecture	Tailoring the mechanical and physical properties of propellants and pyrotechnics Combustion: Kinetic and thermodynamic effects
Week 4 : 5 August - 9 August	Lecture	Thermodynamics and gas dynamics Performance metrics
Week 5 : 12 August - 16 August	Lecture	Heat flow and EO design Insulation
Week 6 : 19 August - 23 August	Lecture	Special topics: Solid fuel ramjets Spectrally matched infrared countermeasures
Week 7 : 9 September - 13 September	Lecture	Guns: Internal ballistics Applications of pyrotechnics: countermeasures, simulants, screening/ signalling etc
Week 8 : 16 September - 20 September	Lecture	Smoke production Liquid, solid and gel propellants in guns: practical and theoretical limitations
Week 9 : 23 September - 27 September	Lecture	Industrial production of propellants and pyrotechnics Pyrotechnic munition design
Week 10 : 30 September - 4 October	Lecture	Nozzle design Thrust vectoring in rockets
Week 11 : 7 October - 11 October	Lecture	Logistical challenges: SRM vs LRE fuels and oxidisers Turbopumps
Week 12 : 14 October - 18 October	Lecture	Vulnerability Case Study: Analyse an EO pyrotechnic system with regard to a specific safety, performance and signature requirement set

Attendance Requirements

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

General Schedule Information

This schedule may vary slightly in response to student cohort input

Course Resources

Prescribed Resources

Akhavan, J: The Chemistry of Explosives, 3rd Ed, RSC Publishing (2011), ISBN: 978-1-84973-330-4

Carlucci, D.E., Jacobson, S. S., Ballistics: Theory and Design of Guns and Ammunition, CRC Press (2007), ISBN: 9 781420066 197

Conkling, J.A. and Mocella, C., Chemistry of Pyrotechnics: Basic Principles and Theory, Taylor and Francis Ltd (CRC Press), (2019), 3rd ed, ISBN 9781138079922

Fleeman, E.L., Missile Design and System Engineering, American Institute of Aeronautics and Astronautics, Inc. (2012), ISBN: 978-1-60086-908-2

Hazell, PJ: Armour: Materials, Theory, and Design, CRC Press (2015), 2nd ed ISBN: 9780367419714

Hazell, PJ: The Story of the Gun: History, Science, and Impact on Society, Springer (2021), ISBN: 978-3-030-73652-1

Sutton, G.P. and Biblarz, O.:Rocket Propulsion Elements, Wiley (2016), 9th ed ISBN 9781118753651

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 “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.

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	Nicholas Kanizaj				By appointment	No	Yes