UNSW Course Outline

MATS4002 Design and Advanced Ceramics - 2024

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General Course Information

Course Code : MATS4002
Year : 2024
Term : Term 1
Teaching Period : T1
Is a multi-term course? : No
Faculty : Faculty of Science
Academic Unit : School of Materials Science & Engineering
Delivery Mode : In Person
Delivery Format : Standard
Delivery Location : Kensington
Campus : Sydney
Study Level : Undergraduate
Units of Credit : 6

Useful Links

Handbook Class Timetable

Course Details & Outcomes

Course Description

Design with advanced ceramics for structural, thermal, electrical, piezoelectric, chemical, catalytic, and wear applications. Fundamental structure-property relationships underlying thermal shock, mechanical strength and fracture toughness, Weibull modulus and reliability,

piezo-, thermo and optoelectric behaviour, corrosion, wear/abrasion, photocatalysis. Case Studies in design and performance of ceramic materials and products.

Oxide and non-oxide advanced ceramics, design parameters, structure/microstructure-processing-properties relations, thermal properties and materials, chemical (corrosion) properties and materials, mechanical properties and materials, thermomechanical properties and materials, tribological properties and materials, electromechanical properties and materials, magnetic properties and materials, electrical properties and materials, and optoelectronic properties and materials.

Course Aims

The objective of the course is to familiarise students with the full range of materials, properties, applications, and design requirements necessary for the utilisation of high-performance ceramics in modern technological functions. The main design parameters that will be understood are defined by the thermal, chemical, mechanical, thermomechanical, tribological, electromechanical, magnetic, electrical, and optoelectronic properties of advanced ceramics. This will assist in building improved understanding of real-life performance scenarios for products made using these materials

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Understand the properties and characteristics of ceramics for high-performance applications.
CLO2 : To be able to assess the range of typical properties of these materials with the aim of utilising them in high-demand designs requiring specific mechanical, thermal, electrical, and other properties.
CLO3 : To understand how to manipulate ceramic microstructures through processing in order to obtain optimal properties for different applications.

Course Learning Outcomes	Assessment Item
CLO1 : Understand the properties and characteristics of ceramics for high-performance applications.	• Mid-term exam • Assignment 2
CLO2 : To be able to assess the range of typical properties of these materials with the aim of utilising them in high-demand designs requiring specific mechanical, thermal, electrical, and other properties.	• Assignment 1 • Final Exam • Mid-term exam • Assignment 2
CLO3 : To understand how to manipulate ceramic microstructures through processing in order to obtain optimal properties for different applications.	• Assignment 1 • Final Exam • Mid-term exam • Assignment 2

Learning and Teaching Technologies

Moodle - Learning Management System | Echo 360 | Microsoft Teams

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Assignment 1	20%	Start Date: Week 1 Due Date: Week 5: 11 March - 17 March
Mid-term exam	30%	Start Date: Week 7 Due Date: Week 7: 25 March - 31 March
Assignment 2	15%	Start Date: Week 9 Due Date: Week 10: 15 April - 21 April
Final Exam	35%	Start Date: Exam Period Due Date: Exam Period

Assessment Details

Assignment 1

Assessment Overview

Students are required to undertake a task involving the application of functional properties including electrical, electronic, optical and magnetic properties covered in Weeks 1-4. It is designed to introduce the students to a broader range of functionalities and practical applications of state-of-the-art ceramics and related materials and to provide formative assessment of the learning process

Feedback will be given two weeks after submission of the assignment and take the form of the mark for the assignment, overall comments on how the class performed, any common areas that were not answered correctly. Additionally, personal feedback and how each student performed may be given.

Course Learning Outcomes

- CLO2 : To be able to assess the range of typical properties of these materials with the aim of utilising them in high-demand designs requiring specific mechanical, thermal, electrical, and other properties.
- CLO3 : To understand how to manipulate ceramic microstructures through processing in order to obtain optimal properties for different applications.

Assignment submission Turnitin type

Not Applicable

Mid-term exam

Assessment Overview

Electrical, electromechanical, magnetic and optoelectronic properties, and materials

Feedback: Students will receive their marked exams indicating what questions were answered correctly and incorrectly. Overall comments and worked solutions may be provided to the class.

Course Learning Outcomes

- CLO1 : Understand the properties and characteristics of ceramics for high-performance applications.
- CLO2 : To be able to assess the range of typical properties of these materials with the aim of utilising them in high-demand designs requiring specific mechanical, thermal, electrical, and other properties.
- CLO3 : To understand how to manipulate ceramic microstructures through processing in order to obtain optimal properties for different applications.

Assessment information

in-person exam

Assignment submission Turnitin type

Not Applicable

Hurdle rules

Satisfactory completion of the course includes the requirement to achieve >35% in the mid-term exam and >35% in the final exam, and >45% weighted average over the two exams.

Assignment 2

Assessment Overview

Students will be required to conduct research on a topic involving materials, properties, performance, of advanced ceramic products in terms of their mechanical / tribological / thermal / thermomechanical / corrosion / nuclear/ biological properties for further learning on current and relevant applications and issues related to the properties and processing of these materials and formative assessment of the learning process

Feedback will be given two weeks after submission of the assignment and take the form of the mark for the assignment, overall comments on how the class performed, any common areas that were not answered correctly. Additionally, personal feedback and how each student performed may be given.

Course Learning Outcomes

- CLO1 : Understand the properties and characteristics of ceramics for high-performance applications.
- CLO2 : To be able to assess the range of typical properties of these materials with the aim of utilising them in high-demand designs requiring specific mechanical, thermal, electrical, and other properties.
- CLO3 : To understand how to manipulate ceramic microstructures through processing in order to obtain optimal properties for different applications.

Assignment submission Turnitin type

Not Applicable

Final Exam

Assessment Overview

Mechanical, tribological, thermal, thermomechanical, chemical, nuclear and biological properties

Feedback: Students will receive their final mark.

Course Learning Outcomes

- CLO2 : To be able to assess the range of typical properties of these materials with the aim of utilising them in high-demand designs requiring specific mechanical, thermal, electrical, and other properties.
- CLO3 : To understand how to manipulate ceramic microstructures through processing in order to obtain optimal properties for different applications.

Detailed Assessment Description

In-person exam

Assignment submission Turnitin type

Not Applicable

Hurdle rules

Satisfactory completion of the course includes the requirement to achieve >35% in the mid-term exam and >35% in the final exam, and >45% weighted average over the two exams.

General Assessment Information

Short Extensions:

The School of Materials Science and Engineering has reviewed its range of assignments and projects to determine their suitability for automatic short extensions as set out by the UNSW Short Extension Policy. After consultation with teaching staff and examination of our course offerings we consider our current deadline structures already accommodate the possibility of unexpected circumstances that may lead students to require additional days for submission. Consequently, the School does not offer the Short Extension provision in its MATS courses but students, if needed, can apply for formal Special Consideration via the usual procedure.

Grading Basis

Standard

Requirements to pass course

Unsatisfactory Fail Grade:

Satisfactory completion of the course includes the requirement to achieve >35% in the mid-term exam and >35% in the final exam, and >45% weighted average over the two exams.

Students who fail to achieve this will be awarded an Unsatisfactory Fail (UF) grade for the course

regardless if they receive over 50% in total for the course.

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 12 February - 18 February	Lecture	Introduction Introduction to electroceramics Ferroelectric ceramic and their applications
Week 2 : 19 February - 25 February	Lecture	Ferroelectric ceramic and their applications Piezoelectric ceramics
Week 3 : 26 February - 3 March	Lecture	Piezoelectric ceramics Fibre-Optic Sensors Magnetic ceramics
Week 4 : 4 March - 10 March	Lecture	Magnetic ceramics and their applications Revision
Week 5 : 11 March - 17 March	Lecture	Introduction to Advanced Ceramic Processing Mechanical Properties of Ceramics
Week 6 : 18 March - 24 March	Other	Flexibility week Week six is known as 'flexi week', no classes are held this week to give students an opportunity to focus on assessable tasks and revising course content.
Week 7 : 25 March - 31 March	Lecture	Mechanical/Tribological Properties of Ceramics Thermal Properties of Ceramics
Week 8 : 1 April - 7 April	Lecture	Thermal Properties of Ceramics Thermomechanical Properties of Ceramics
	Laboratory	Lab Week 1
Week 9 : 8 April - 14 April	Lecture	Chemical (corrosion) Properties of Ceramics Nuclear Properties of Ceramics
	Laboratory	Lab Week 2
Week 10 : 15 April - 21 April	Lecture	Biological Properties
	Laboratory	Lab Week 3

Attendance Requirements

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

Course Resources

Recommended Resources

• A.J. Moulson and J.M. Herbert, Electroceramics: Materials, Properties, Applications, 2nd Edition, John Wiley & Sons, 2003

• K. Uchino, Piezoelectric Actuators and Ultrasonic Motors, Kluwer Academic Publishers, 1997

• Y. Xu, Ferroelectric Materials and Their Applications, North-Holland, 1991

• A.V. Srinivasan and D. Michael McFarland, Smart Structures: Analysis and Design, Cambridge University Press, 2001

• S.O. Kasap, Principles of Electrical Engineering Materials and Devices, Revised Edition. McGraw-Hill, Boston, 2000.

• D.J. Green, An Introduction to the Mechanical Properties of Ceramics. Cambridge University Press, Cambridge, 1998.

• D. Munz, T. Fett, Ceramics – Mechanical Properties, Failure Behaviour, Materials Selection. Springer-Verlag Berlin Heidelberg, 1999

• R. Morrell, Handbook of Properties of Technical & Engineering Ceramics. Part 1: An Introduction for the Engineer and Designer. HMSO, London, 1989

• W.E.C. Creyke, I.E.J. Sainsbury, and R. Morrell, Design with Non-Ductile Materials. Applied Science, London, 1982.

• J.B. Wachtman, Mechanical Properties of Ceramics. John Wiley, New York, 1996.

• S. Jahanmir, Editor, Friction and Wear of Ceramics. Marcel Dekker, New York, 1994.

• W.D. Kingery, H.K. Bowen, & D.R. Uhlmann, Introduction to Ceramics, 2nd Ed. John Wiley, New York, 1976.

• R.A. McCauley, Corrosion of Ceramics. Marcel Dekker, New York, 1995.

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	Danyang Wang		239 Hilmer Building	02 9385 7170	by appointment	Yes	Yes
Lecturer	Pramod Koshy		120 Hilmer Building	02 9385 6038	by appointment	No	No

Other Useful Information

Academic Information

Upon your enrolment at UNSW, you share responsibility with us for maintaining a safe, harmonious and tolerant University environment.

You are required to:

- Comply with the University's conditions of enrolment.
- Act responsibly, ethically, safely and with integrity.
- Observe standards of equity and respect in dealing with every member of the UNSW community.
- Engage in lawful behaviour.
- Use and care for University resources in a responsible and appropriate manner.
- Maintain the University's reputation and good standing.

For more information, visit the UNSW Student Code of Conduct Website.

Academic Honesty and Plagarism

Referencing is a way of acknowledging the sources of information that you use to research your assignments. You need to provide a reference whenever you draw on someone else's words, ideas or research. Not referencing other people's work can constitute plagiarism.
Further information about referencing styles can be located at https://student.unsw.edu.au/referencing

Academic integrity is fundamental to success at university. Academic integrity can be defined as a commitment to six fundamental values in academic pursuits: honesty, trust, fairness, respect, responsibility and courage. At UNSW, this means that your work must be your own, and others' ideas should be appropriately acknowledged. If you don't follow these rules, plagiarism may be detected in your work.
Further information about academic integrity, plagiarism and the use of AI in assessments can be located at:

- The Current Students site,
- The ELISE training site, and
- The Use of AI for assessments site.

The Student Conduct and Integrity Unit provides further resources to assist you to understand your conduct obligations as a student: https://student.unsw.edu.au/conduct

Submission of Assessment Tasks

Penalty for Late Submissions

UNSW has a standard late submission penalty of:

- 5% per day,
- for all assessments where a penalty applies,
- capped at five days (120 hours) from the assessment deadline, after which a student cannot

submit an assessment, and
- no permitted variation.

Any variations to the above will be explicitly stated in the Course Outline for a given course or assessment task.

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

Special Consideration

If circumstances prevent you from attending/completing an assessment task, you must officially apply for special consideration, usually within 3 days of the sitting date/due date. You can apply by logging onto myUNSW and following the link in the My Student Profile Tab. Medical documentation or other documentation explaining your absence must be submitted with your application. Once your application has been assessed, you will be contacted via your student email address to be advised of the official outcome and any actions that need to be taken from there. For more information about special consideration, please visit: https://student.unsw.edu.au/special-consideration

Important note: UNSW has a "fit to sit/submit" rule, which means that if you sit an exam or submit a piece of assessment, you are declaring yourself fit to do so and cannot later apply for Special Consideration. This is to ensure that if you feel unwell or are faced with significant circumstances beyond your control that affect your ability to study, you do not sit an examination or submit an assessment that does not reflect your best performance. Instead, you should apply for Special Consideration as soon as you realise you are not well enough or are otherwise unable to sit or submit an assessment.

Faculty-specific Information

Additional support for students

- The Current Students Gateway
- Student Support
- Academic Skills and Support
- Student Wellbeing, Health and Safety
- Equitable Learning Services
- UNSW IT Service Centre
- Science EDI Student Initiatives, Offerings and Guidelines