Course Outline

MATS6107

Thermal Properties of Ceramics

Materials Science and Engineering

Science

T1, 2022
1. Staff

<table>
<thead>
<tr>
<th>Position</th>
<th>Name</th>
<th>Email</th>
<th>Consultation times and locations</th>
<th>Contact Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Convenor</td>
<td>Prof. Nagarajan Valanoor</td>
<td><a href="mailto:nagarajan@unsw.edu.au">nagarajan@unsw.edu.au</a></td>
<td>Room 247, School of Materials Science and Engineering (Building E10), by appointment</td>
<td>Phone: 9385 4263</td>
</tr>
<tr>
<td>Lecturer</td>
<td>A/Prof Danyang Wang</td>
<td><a href="mailto:dy.wang@unsw.edu.au">dy.wang@unsw.edu.au</a></td>
<td>Room 239, School of Materials Science and Engineering (Building E10), by appointment</td>
<td>Phone: 9385 7170</td>
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<tr>
<td>Lecturer</td>
<td>Dr. Peggy Zhang</td>
<td><a href="mailto:peggy.zhang@unsw.edu.au">peggy.zhang@unsw.edu.au</a></td>
<td>Room 243, School of Materials Science and Engineering (Building E10), by appointment</td>
<td></td>
</tr>
</tbody>
</table>

2. Course information

Units of credit: 6
Pre-requisite(s): None
Timetabling website: http://timetable.unsw.edu.au/2021/MATS6107.html#S1-1189

Teaching times and locations:

<table>
<thead>
<tr>
<th>Part</th>
<th>Lecture</th>
<th>Lecture</th>
<th>Lecture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day</td>
<td>Monday</td>
<td>Tuesday</td>
<td>Wednesday</td>
</tr>
<tr>
<td>Location</td>
<td>Online</td>
<td>Online</td>
<td>Online</td>
</tr>
<tr>
<td>Time</td>
<td>14:00 - 16:00</td>
<td>09:00 - 11:00</td>
<td>10:00-12:00</td>
</tr>
<tr>
<td>Weeks</td>
<td>1-4</td>
<td>1-4</td>
<td>1-4</td>
</tr>
</tbody>
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<td>Tuesday</td>
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<td></td>
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<tr>
<td>Location</td>
<td>Online</td>
<td>Online</td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>10:00-12:00</td>
<td>11:00-13:00</td>
<td></td>
</tr>
<tr>
<td>Weeks</td>
<td>7-10</td>
<td>7-10</td>
<td></td>
</tr>
</tbody>
</table>
2.1 Course summary
This course covers the thermal properties of materials, especially high temperatures ceramic materials. Emphasis is placed on enhancing the thermal stability, toughness and strength of these materials. Processing methods used to manufacture these materials will also be studied.

2.2 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 electromechanical, magnetic, electrical, optoelectronic, thermal and electrothermal properties of advanced ceramics and related materials.

2.3 Course learning outcomes (CLO)
At the successful completion of this course you (the student) should be able to:
1. Understand the principles underlying the functional and thermal behaviour of ceramic materials
2. Articulate the common strategies used to enhance functional performance for energy applications in ceramic materials
3. An appreciation of real-life performance scenarios for products made from these materials

2.4 Relationship between course and program learning outcomes and assessments

<table>
<thead>
<tr>
<th>Course Learning Outcome (CLO)</th>
<th>LO Statement</th>
<th>Program Learning Outcome (PLO)</th>
<th>Related Tasks &amp; Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLO 1</td>
<td>Understand...</td>
<td>3</td>
<td>1, 2, &amp; 3</td>
</tr>
<tr>
<td>CLO 2</td>
<td>Articulate...</td>
<td>1</td>
<td>1, 2, &amp; 3</td>
</tr>
<tr>
<td>CLO 3</td>
<td>An appreciation...</td>
<td>4</td>
<td>1, 2, &amp; 3</td>
</tr>
</tbody>
</table>

3. Strategies and approaches to learning

3.1 Learning and teaching activities
(based on UNSW Learning Guidelines)

Students are actively engaged in the learning process.

It is expected that, in addition to attending classes, students read, write, discuss, and are engaged in solving problems on the thermal properties of materials, and in analysis and evaluation of materials’ and devices’ performance using electron/photon-related properties.
• **Effective learning is supported by a climate of inquiry where students feel appropriately challenged.**
  Problems involving electron theory are challenging; students will be given assignments that will motivate deep analysis of various physical phenomena in materials science and engineering.
• **Learning is more effective when students’ prior experience and knowledge are recognised and built on.**
  This course is built on prior courses in ceramic processing.
• **Students become more engaged in the learning process if they can see the relevance of their studies to professional and disciplinary contexts**
  Students will be asked to analyse the critical role of functional properties such as ferroelectricity and thermoelectrics in the application of advanced ceramic materials and design of novel devices.

3.2 Expectations of students

• Students must attend at least 80% of all classes with the expectation that students only miss classes due to illness or unforeseen circumstances
• Students must read through lecture notes and lab sheets prior to class
• During class, students are expected to engage actively in class discussions
• Students should work through lecture, tutorial and textbook questions
• Students should read through the relevant chapters of the prescribed textbook.
• Students should complete all assessment tasks and submit them on time.
• Students are expected to participate in online discussions through the Moodle page
4. Course schedule and structure

This course consists of 46 hours of class contact hours. You are expected to take an additional 104 hours of non-class contact hours to complete assessments, readings and exam preparation.

<table>
<thead>
<tr>
<th>Week</th>
<th>Topics</th>
<th>Activity</th>
</tr>
</thead>
</table>
| 1    | Introduction  
Introduction to electroceramics  
Ferroelectric Ceramics and their Applications |                                 |
| 2    | Ferroelectric Ceramics and their Applications  
Piezoelectric ceramics |                                 |
| 3    | Piezoelectric ceramics  
Fibre-Optic Sensors  
Magnetic ceramics | Formative in-class quiz         |
| 4    | Magnetic ceramics and their applications            |                                 |
| 5    | Ferroelectric phase transitions                     | Assignment 1                    |
| 6    | "Flexibility week"                                  | "Flexibility week"              |
| 7    | Pyroelectric Materials and their applications       | Mid-session exam (DW)           |
| 8    | Case study of pyroelectric materials                |                                 |
| 9    | Electrocaloric Materials                            |                                 |
| 10   | Thermoelectric materials and their applications     | Final Exam                      |
5. Assessment

5.1 Assessment tasks

<table>
<thead>
<tr>
<th>Assessment task</th>
<th>Description</th>
<th>Weight</th>
<th>Due date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assignment 1:</td>
<td>Students are required to conduct research about electroceramics and their applications. The topics should be within the scope of electrical, electronic, optical and magnetic properties. 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</td>
<td>20%</td>
<td>Week 5</td>
</tr>
<tr>
<td>Mid-term exam:</td>
<td>Topics: Electrical, electromechanical, magnetic and optoelectronic properties, and materials</td>
<td>30%</td>
<td>Week 7</td>
</tr>
<tr>
<td>Final exam:</td>
<td>Topics: Ferroelectric and Electrothermal properties (pyroelectric, electrocaloric, thermoelectric) Duration: 2 hours</td>
<td>50%</td>
<td>Final exam period</td>
</tr>
</tbody>
</table>

Further information

UNSW grading system: [https://student.unsw.edu.au/grades](https://student.unsw.edu.au/grades)


Please Note: 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.

5.2 Assessment criteria and standards

Assessment criteria and standards for each assessment tasks are available on the course Moodle page.

5.3 Submission of assessment tasks

- Requests for Special Consideration for examinations and other assessment tasks must be submitted in accordance with UNSW policy. It must be noted that merely submitting a request for Special Consideration does not automatically imply the granting of additional assessment or the award of an amended result.

- In the absence of a request for special consideration, the maximal allowable extension for a late completion of assessment tasks is 7 days (includes non-working days) from the due date for that task. The penalty for late submission is a deduction of 10%/day of the total mark for each day, or part thereof after the due date.
• Students unable to submit assignments on time or attend the mid-session quizzes or final exams on health grounds should make a request for special consideration. Information on this process can be found here: https://student.unsw.edu.au/special-consideration. Medical certificates or other appropriate documents must be included. Students should also advise the lecturer of the situation.

• Unless otherwise specified in the task criteria, all assignments must be uploaded via Moodle prior to the due date for submission.

• Students who have a disability that requires some adjustment in their teaching or learning environment are encouraged to discuss their study needs with the course coordinator prior to, or at the commencement of, their course, or with the Equity Officer (Disability) in the Equity and Diversity Unit: https://student.unsw.edu.au/disability. Early notification is essential to enable any necessary adjustments to be made.

• Rules governing conduct during exams are given at: https://student.unsw.edu.au/exam-rules

5.4. Feedback on assessment

Assignments: 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.

Midsession exams: 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.

Final exam: Students will receive their final mark.

6. Academic integrity, referencing and plagiarism

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. ¹ 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 and plagiarism can be located at:

- The Current Students site https://student.unsw.edu.au/plagiarism, and
- The ELISE training site http://subjectguides.library.unsw.edu.au/elise/presenting

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

7. Readings and resources


8. Administrative matters

School Office: Room 137, Building E10 School of Materials Science and Engineering
School Website: [http://www.materials.unsw.edu.au/](http://www.materials.unsw.edu.au/)
Faculty Office: Robert Webster Building, Room 128
Faculty Website: [http://www.science.unsw.edu.au/](http://www.science.unsw.edu.au/)

9. Additional support for students

- The Current Students Gateway: [https://student.unsw.edu.au/](https://student.unsw.edu.au/)
- Academic Skills and Support: [https://student.unsw.edu.au/academic-skills](https://student.unsw.edu.au/academic-skills)
- Student Wellbeing, Health and Safety: [https://student.unsw.edu.au/wellbeing](https://student.unsw.edu.au/wellbeing)
- UNSW IT Service Centre: [https://www.it.unsw.edu.au/students/index.html](https://www.it.unsw.edu.au/students/index.html)