UNSW Course Outline

MATS4005 Composites and Functional Materials - 2024

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General Course Information

Course Code : MATS4005
Year : 2024
Term : Term 3
Teaching Period : T3
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

This course is designed for 3rd, 4th or final year students undertaking studies in the materials science discipline or combined degrees with materials science.

The course aims to enhance knowledge and understanding of two important categories of advanced materials, namely functional materials and composite materials. The classes will comprise of lectures focusing on key topics in these fields, relevant laboratory activities, and design problems related to materials design in these fields.

The functional materials part will focus on fabrication of functional materials in different nanostructural forms (0D, 1D, 2D, MOFs, and composite bulk forms) and design of these materials in advanced devices and applications such as catalysts, batteries, fuel cells, supercapacitors, pseudocapacitors, superconductors, semiconducting devices, photovoltaics, and biosensors)

The composite materials part will focus on different types of composites (polymer, metal, and ceramic matrix composites), their fabrication routes, importance of their properties (strength, modulus, fracture etc.), failure mechanisms in the bulk and individual components, recycling methods, and designing composite materials for different applications (structural and non-structural).

Course Aims

This course aims to provide an explanation of the relationship between structure, processing and properties and failure of functional nanostructured materials and composite materials in order to successfully design these materials for different advanced applications.

Relationship to Other Courses

None

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Explain the properties and characteristics of functional materials and composites for high-performance applications.
CLO2 : Evaluate the correlations of material properties with the fabrication methods in order to determine the optimal processing conditions for different applications.
CLO3 : Design composite materials for structural applications by investigation and selection of constituent materials based on their macro and microstructural material properties.
CLO4 : Investigate and select suitable material properties (microstructural and nanostructural) for the design of functional materials used in energy and environmental applications.

Course Learning Outcomes	Assessment Item
CLO1 : Explain the properties and characteristics of functional materials and composites for high-performance applications.	• Assignment 1 • Mid-Term Test • Assignment 2 • Final Exam
CLO2 : Evaluate the correlations of material properties with the fabrication methods in order to determine the optimal processing conditions for different applications.	• Assignment 1 • Mid-Term Test • Assignment 2 • Final Exam
CLO3 : Design composite materials for structural applications by investigation and selection of constituent materials based on their macro and microstructural material properties.	• Assignment 1 • Mid-Term Test
CLO4 : Investigate and select suitable material properties (microstructural and nanostructural) for the design of functional materials used in energy and environmental applications.	• Assignment 2 • Final Exam

Learning and Teaching Technologies

Moodle - Learning Management System | Microsoft Teams

Learning and Teaching in this course

Classes in person

Recordings on Teams

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Assignment 1 Assessment Format: Individual	15%	Start Date: Week 3 Due Date: Week 5/6
Mid-Term Test Assessment Format: Individual	35%	Start Date: Week 7 Due Date: Not Applicable
Assignment 2 Assessment Format: Individual	15%	Start Date: Week 8/9 Due Date: Week 10
Final Exam Assessment Format: Individual	35%	Start Date: Exam period Due Date: Not Applicable

Assessment Details

Assignment 1

Assessment Overview

You will undertake an assignment on the application of the topics covered in Weeks 1-4 with focus on researching current trends in the field and applying classroom concepts in an application scenario. The submission is in the form of a one page document. Assessment 1 will be due in week 4.

Feedback will be given two weeks after submission, and this will include your marked assignment and overall comments on how the class performed.

Course Learning Outcomes

- CLO1 : Explain the properties and characteristics of functional materials and composites for high-performance applications.
- CLO2 : Evaluate the correlations of material properties with the fabrication methods in order to determine the optimal processing conditions for different applications.
- CLO3 : Design composite materials for structural applications by investigation and selection of constituent materials based on their macro and microstructural material properties.

Detailed Assessment Description

Short assignment to summarise recent developments in field + mathematical problem

Assessment Length

Max 5 pages

Assignment submission Turnitin type

This assignment is submitted through Turnitin and students can 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.

Mid-Term Test

Assessment Overview

This test is designed to assess your learning of the topics covered in Weeks 1-4. It will be 2 h in duration and will typically be held in Week 7.

The format will be in person (hand-written, single attempt) and will focus on application of understanding of topics gained from lectures to answer descriptive and mathematical questions related to the properties and design of the materials for these applications.

Feedback: Students will receive their feedback on the 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 : Explain the properties and characteristics of functional materials and composites for high-performance applications.
- CLO2 : Evaluate the correlations of material properties with the fabrication methods in order to determine the optimal processing conditions for different applications.
- CLO3 : Design composite materials for structural applications by investigation and selection of constituent materials based on their macro and microstructural material properties.

Detailed Assessment Description

Face-to-face written examination covering topics from Week 1-5

Assessment Length

2 hours

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.
For more information on Generative AI and permitted use please see here.

Assignment 2

Assessment Overview

You will undertake an assignment on the application of the topics covered in Weeks 5-9 with focus on researching current trends in the field and applying classroom concepts in an application scenario. Assessment 2 is due in week 10.

Feedback will be given within one week after submission (before the final exam), and this includes your marked assignment and overall comments on how the class performed.

Course Learning Outcomes

- CLO1 : Explain the properties and characteristics of functional materials and composites for high-performance applications.
- CLO2 : Evaluate the correlations of material properties with the fabrication methods in order to determine the optimal processing conditions for different applications.
- CLO4 : Investigate and select suitable material properties (microstructural and nanostructural) for the design of functional materials used in energy and environmental applications.

Detailed Assessment Description

Short assignment to summarise recent developments in field + mathematical problem

Assessment Length

Max 5 page

Assignment submission Turnitin type

This assignment is submitted through Turnitin and students can 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.
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Final Exam

Assessment Overview

The final exam is designed to assess your learning of the topics covered in Weeks 5-10. It will be 2 h in duration and will be held during the final exam period

The exam will focus on application of understanding of topics gained from lectures to answer descriptive and mathematical questions related to the properties and design of the materials for these applications.

Feedback: Students will receive their final mark and feedback is available through inquiry with the course convenor.

Course Learning Outcomes

- CLO1 : Explain the properties and characteristics of functional materials and composites for high-performance applications.
- CLO2 : Evaluate the correlations of material properties with the fabrication methods in order to determine the optimal processing conditions for different applications.
- CLO4 : Investigate and select suitable material properties (microstructural and nanostructural) for the design of functional materials used in energy and environmental applications.

Detailed Assessment Description

Face-to-face written examination covering topics from Week 5-10

Assessment Length

2 hours

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.
For more information on Generative AI and permitted use please see here.

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 shortextensions 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

Students are required to achieve a mark of at least 35% in this final exam (and at least 45% weighted average for this final exam and the mid-term test) to pass the course otherwise an Unsatisfactory Fail (UF) grade may be awarded.

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 0 : 2 September - 8 September	Other	O-Week
Week 1 : 9 September - 15 September	Lecture	Koshy (Monday) - Introduction to Functional Materials (Monday) Sajjad (Tuesday, Thursday) - Introduction to composites - Reinforcing phase
Week 2 : 16 September - 22 September	Lecture	Koshy (Monday) - Fabrication of Nanostructures Sajjad (Tuesday/Thursday) - Reinforcing Phase - 2 - Matrix
Week 3 : 23 September - 29 September	Lecture	Koshy (Monday) - Fabrication of Nanostructures Sajjad (Tuesday/Thursday) - Micromechanics of Composites (1) - Micromechanics of Composites (2)
Week 4 : 30 September - 6 October	Lecture	Koshy (Monday) - Fabrication of Nanostructures Sajjad (Tuesday/Thursday) - Fatigue and Fracture in Composites - Recycling and Characterisation of Composites - Revision
Week 5 : 7 October - 13 October	Lecture	Zhi (Tuesday/Thursday) - Design of Semiconductor Devices
	Assessment	Assignment 1 due
Week 6 : 14 October - 20 October	Other	Break Week
Week 7 : 21 October - 27 October	Lecture	Zhi (Monday) - Superconductors Koshy (Tuesday/Thursday) - Catalytic Materials
	Assessment	Mid-term Exam
Week 8 : 28 October - 3 November	Laboratory	Lab set 1 (Tuesday)
	Lecture	Koshy (Monday, Tuesday, Thursday) - Catalytic Materials - Materials for Hydrogen Storage
Week 9 : 4 November - 10 November	Lecture	Koshy (Monday, Tuesday, Thursday) - Design of Devices and Materials for Energy Storage
	Laboratory	Lab (set 2)
Week 10 : 11 November - 17 November	Lecture	Koshy (Monday, Tuesday, Thursday) - Design of Devices and Materials for Energy Storage
	Assessment	Assignment 2 Due
	Laboratory	Lab (Set 3)
Week 11 : 18 November - 24 November	Lecture	Koshy (Monday) - Revision
Week 12 : 25 November - 1 December	Assessment	Exam Week

Attendance Requirements

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

General Schedule Information

Classes are in person and interactive (6 hours per week). Recordings of lectures will be provided after lecture. Lecture slides will also be provided after the lecture.

Course Resources

Prescribed Resources

Lecture slides and attendance of lectures in person

Recommended Resources

Functional Materials

- Processing of Semiconductors, ed. K.A. Jackson et al. VCH, 1996.
- Functional Materials: Preparation, Processing and Applications, S Banerjee & A.K. Tyagi Elsevier 2012
- The Science and Engineering of Microelectronic Fabrication, S. A. Campbell, OUP, 1996.
- Materials for Semiconductor Devices, C. R. M. Grosvenor, Institute of Metals, 1987.
- Semiconductor Devices, N.M. Morris, McMillan, 1976.
- Nanoelectronics and Information Technology-Advanced Electronic Materials and Novel Devices, Edited By Rainer Waser, Wiley-VCH, 2003.
- Physics of Functional Materials: H Fredriksson, Wiley 2008.

Composite Materials

- An Introduction to Composite Materials, 2012, 2nd edition, D. Hull, University of Liverpool , T.W. Clyne, University of Cambridge.
- Principles of Composite Material Mechanics, 2016, 4th Edition, Ronald F. Gibson, CRC Press.
- Fiber-reinforced composites: Materials, Manufacturing and Design, 2007, 3rd Edition, P.K. Mallick, CRC Press.
- Advanced Fibre-reinforced polymer (FRP) composites for structural applications, 2013, A volume in Civil and Structural Engineering, Jiping Bai, Woodhead publishing.
- Management, Recycling and Reuse of Waste Composites, 2010, A volume in Composites Science and Engineering, Vanessa Goodship, Woodhead publishing.

Additional Costs

N/A

Course Evaluation and Development

This course has had highly positive feedback and thus no further changes are required especially considering that this is the second last year of this course being run

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Lecturer	Sajjad Seifi Mofarah		Room 711 Building F10	Teams	Email to fix meeting time	No	No
	Zhi Li		Room 240 Building E10	9385 4090	Email to fix meeting time	No	No
Convenor	Pramod Koshy		Room 120 Building E10	9385 6038	Email to fix meeting time	Yes	Yes

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