Course Outline

MATS4005

Composites and Functional Materials

Materials Science and Engineering

Science

T3, 2022

1. Staff

Position	Name	Email	Consultation times and locations	Contact Details
Course Convenor	Dr. Pramod Koshy	koshy@unsw.edu.au	Room 120, School of Materials Science and Engineering (Building E10)	Phone: 9385 6565
Lecture	Dr. Sajjad Mofarah	s.seifimofarah@unsw.edu.au	Desk 235.04, School of Materials Science and Engineering (Building E10)	Phone via Teams
Lecturer	Dr. Zhi Li	zhi.li5@unsw.edu.au	Room 240, School of Materials Science and Engineering (Building E10)	Phone: 9385 4090

2. Course information

Units of credit: 6
Pre-requisite(s): None (However, knowledge from 3rd year courses MATS3001/3002/3004 would help)
Timetabling website: TBA
Teaching times and locations:

	Lecture	Lecture	Lecture
Day	Monday	Tuesday	Thursday
Location	Science & Engineering G05 (K-E8-G05)	Science & Engineering B26 (K-E8-B26)	Science & Engineering G05 (K-E8-G05)
Time	15.00 – 17.00	9.00 – 11.00	15.00 – 17.00
Weeks	1-5, 7-10	1-5, 7-10	1-5, 7-10

2.1 Course summary

The course deals with two important categories of advanced materials, namely functional materials and composite materials.

The functional materials part will focus on the following topics: Basic principles of semiconductors and their fabrication processes for electronic devices, design and characteristics of functional materials for supercapacitors and batteries, metal-organic frameworks, design of nanostructured functional materials in different configuration (3D, 2D, and 1D) and for different applications (superconductors, supercapacitors, batteries, fuel cells, catalysts, photovoltaics)

The composite materials part will focus on the following topics: Properties of fibre reinforced polymer matrix composites, metal matrix composites, ceramic matrix composites; fibres, matrices and fibre/matrix interface; mechanical behaviour of fibre reinforced composites; fracture and durability of composites; composite structure and design; testing, composite manufacture and recycling.

2.2 Course aims

The objective of this course is to develop a strong understanding for the relationships between structure, processing and properties and failure of functional materials and composite materials for advanced applications

2.3 Course learning outcomes (CLO)

At the successful completion of this course you (the student) should be able to:

1. Demonstrate an understanding the properties and characteristics of functional materials and composites for high-performance applications
2. Make an assessment of the correlations of the material properties with the fabrication methods in order to determine the optimal processing conditions for different applications
3. Demonstrate an understanding of how to select and tailor these advanced materials for different applications.

2.4 Relationship between course and program learning outcomes and assessments

Course Learning Outcome (CLO)	LO Statement	Program Learning Outcome (PLO)	Related Tasks & Assessment
CLO 1	Describe…	1.3	1, 2, 3 & 4
CLO 2	Make…	1.3	1, 2, 3 & 4

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 will read, write, discuss, and engage in analysing the course content.

- *Effective learning is supported by a climate of inquiry where students feel appropriately challenged.*

Students are expected to be challenged by the course content and to challenge their own preconceptions, knowledge, and understanding by questioning information, concepts, and approaches during class and study.

- *Learning is more effective when students' prior experience and knowledge are recognised and built on.*

Coursework, tutorials, assignments, laboratories, examinations, and other forms of learning and assessment are intended to provide students with the opportunity to cross-reference these activities in a meaningful way with their own experience and knowledge.

- *Students become more engaged in the learning process if they can see the relevance of their studies to professional and disciplinary contexts*

The course content is designed to incorporate both theoretical and practical concepts, where the latter is intended to be applicable to real-world situations and contexts.

Lectures: The core concepts will be taught in lectures, students may be provided lecture notes before class for annotation during the lecture. Students will be engaged in the learning process through class discussions and problem-solving questions independently and working together with partners and groups.

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 may be required to 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 52 hours of class contact hours. You are expected to take an additional 98 hours of non-class contact hours to complete assessments, readings and exam preparation spread over the term.

Week	Topics	Activity	
1	Introduction of composites Fibres, resin and core materials		**SM**
2	Micromechanics Fatigue and fracture		**SM**
3	Structure design Composite manufacturing Characterization and Non-destructive testing		**SM**
4	Introduction to Functional Materials / Fabrication		**PK**
5	Design of Semiconductor Devices	Assignment 1	**ZL**
6	Mid-Session Break		
7	Superconductors	Mid-term exam	**ZL**
8	Catalytic Materials for Environmental Materials	Lab	**PK**
9	Design of Devices and Materials for Energy Storage (Supercapacitors/Batteries/Fuel Cells)/Photovoltaics	Lab	**PK**
10	Materials for Hydrogen Storage/	Lab Assignment 2	**PK**
	Final exam		

5. Assessment

5.1 Assessment tasks

Assessment task	Description	Weight	Due date
Individual assignment:	You will undertake a task involving the application of the topics covered in Weeks 1-3	15%	Week 5
Mid-term exam:	This examination will be the final examination for the topics learnt in Weeks 1-4 (2 h)	35%	Week 7
Individual assignment:	You will undertake a task involving the application of the knowledge and techniques covered in Weeks 5~10	15%	Week 10
Final exam:	The final exam will 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	35%	Final exam period

Further information

UNSW grading system: https://student.unsw.edu.au/grades

UNSW assessment policy: https://student.unsw.edu.au/assessment

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

- 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.
- Assignments/lab reports submitted after the due date for submission will receive a 10% of maximum grade penalty for every day late, or part thereof.
- 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.

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

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.

[1] International Center for Academic Integrity, 'The Fundamental Values of Academic Integrity', T. Fishman (ed), Clemson University, 2013.

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, Vannessa Goodship, Woodhead publishing.

8. Administrative matters

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

9. Additional support for students

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