



# Course Outline

MATS6108

Functional Properties of Materials

Materials Science and Engineering

Science

T2, 2019

## 1. Staff

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Position	Name	Email	Consultation times and locations	Contact Details
Course Convenor	Dr Nitish Kumar	<a href="mailto:nitish.kumar@unsw.edu.au">nitish.kumar@unsw.edu.au</a>	Room 422, School of Materials Science and Engineering (Building E10), by appointment	Phone: 9385 6315
Lecturer	Dr. Dewei Chu	<a href="mailto:d.chu@unsw.edu.au">d.chu@unsw.edu.au</a>	Room 244, School of Materials Science and Engineering (Building E10), by appointment	Phone: 9385 5090

## 2. Course information

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Units of credit: 6

Pre-requisite(s):

Timetabling website: TBA

Teaching times and locations:

Part 1:	Lecture	Lecture	Lecture
Day	Monday	Wednesday	Thursday
Location	Chemical Sc M11	Chemical Sc M11	Chemical Sc M11
Time	14:00-16:00	9:00-11:00	9:00-11:00
Weeks	1, 3-6	1-4	1-3, 6

Part 2:	Lecture	Lecture
Day	Monday	Wednesday
Location	UNSW Business School 205	UNSW Business School 205
Time	14:00-16:00	9:00-11:00
Weeks	7-11	6-7

### 2.1 Course summary

This course covers the fabrication, structure, properties and applications of composite and functional materials. Students will gain an understanding of the relationship between materials design, fabrication and behaviour of these materials.

## 2.2 Course aims

The objective of this course is to develop a sound understanding in the relationships between materials structure, processing, properties and applications of various materials for electronic and magneto-electronic applications.

## 2.3 Course learning outcomes (CLO)

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

1. Understand the principles, processing, structure and functional properties (including mechanical) of composite and functional materials.
2. Relate the behaviour of functional materials to their composition and architecture.
3. Appreciate the complexity and precision required in the fabrication of composite and functional materials and describe relationships between materials structures, properties and processes
4. Make informed decisions in materials selection for engineering design.

## 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	Understand...	3	1, 2,3 & 4
CLO 2	Relate...	5	1, 2,3 & 4
CLO 3	Appreciate...	3	1, 2,3 & 4
CLO 4	Appreciate...	3	1, 2,3 & 4

## 3. Strategies and approaches to learning

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### 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 will have access to the lectures 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 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

Think critically in decision making and problem-solving

Communicate with correct terminology

Conduct online research

## 4. Course schedule and structure

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This course consists of 38 hours of class contact hours. You are expected to take an additional 112 hours of non-class contact hours to complete assessments, readings and exam preparation.

Week	Topics	Activity
1	Overview of semiconductor materials and physics Theories of semiconducting behaviour	
2	Basic semiconductor devices Methods of single crystal growth and purification	
3	Methods of single crystal growth and purification Device fabrication: Oxidation and epitaxy Device fabrication: Lithographic methods, diffusion and ion implantation	Formative in-class quiz
4	Device fabrication: Lithographic methods, diffusion and ion implantation	
5	Band theory of solids applied to electronic and magnetic materials Materials synthesis (solid-state synthesis, thin films deposition)	Individual assignment
6	Transport properties, Non-stoichiometry in semiconductors and Defect Chemistry	Mid-term exam
7	Review of electrostatics, Dielectrics (linear and non-linear), Piezoelectricity	
8	Magnetic Phenomenon (basic ideas, Diamagnetic materials, Paramagnetic materials, Ferromagnetic, Ferrimagnetic materials) Introduction to Magnetoelectricity and Piezomagnetism	
9	Materials for electronic and magnetic applications and case studies	
10	10 min presentations from students on selected topics	Group presentation

## 5. Assessment

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### 5.1 Assessment tasks

Assessment task	Description	Weight	Due date
<b>Literature review:</b>	Students will be required to conduct research (literature review) on following topics; (1) Electronic devices such as; non-volatile memories, transistors etc. (2) Devices involved Magnetic fields, magnetic moments, or current induced magneto-electronic effects. A formal document, written to professional standard (2500-3000 words)	15%	Week 5
<b>Mid-term exam:</b>	This examination will be the final examination for the topics learnt in Weeks 1-5	35%	Week 6
<b>Group assignment:</b>	Each group of students will be required to do a 10-minute presentation on their selected topics from the core content taught from weeks 5-10. No two groups can take the same topic; however, topics will need to be discussed with tutor between weeks 5-10. The marking will be dependent on the audience engagement and 10 minutes Q&A session after presentation.	30%	Week 10
<b>Final Exam:</b>	The final exam will assess your learning of the topics covered in Weeks 5-10. It will be 2.0 hrs in duration.	20%	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.

Students who fail to achieve a score of at least 40% for the overall exam component (i.e., mid-session exam and final exam marks combined), but achieve a final mark >50% for the course, will be awarded a UF (Unsatisfactory Fail) for the course.

Please refer to the UNSW guide to grades: <https://student.unsw.edu.au/grades>

### 5.3 Submission of assessment tasks

UNSW operates under a Fit to Sit/ Submit rule for all assessments. If a student wishes to submit an application for special consideration for an exam or assessment, the application must be submitted prior to the start of the exam or before an assessment is submitted. If a student sits the exam/ submits an assignment, they are declaring themselves well enough to do so. 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 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

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**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.<sup>1</sup> 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

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- Materials for Semiconductor Devices, C. R. M. Grosvenor, Institute of Metals, 1987.

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<sup>1</sup> International Center for Academic Integrity, 'The Fundamental Values of Academic Integrity', T. Fishman (ed), Clemson University, 2013.

- The Science and Engineering of Materials (Sixth Edition), Donald R. Askeland, Pradeep P. Fulay, Wendelin J. Wright, Cengage Learning, 2010.
- Processing of Semiconductors, ed. K.A. Jackson et al. VCH, 1996.
- The Science and Engineering of Microelectronic Fabrication, S. A. Campbell, OUP, 1996.
- Nanoelectronics, Nanowires, Molecular Electronics and Nanodevices, Edited by Krzysztof Iniewski, McGraw Hill, 2011
- Semiconductor Devices, N.M. Morris, McMillan, 1976.
- Nanoelectronics and Information Technology-Advanced Electronic Materials and Novel Devices, Edited By Rainer Waser, Wiley-VCH, 2003.

## 8. Administrative matters

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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

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- 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>
- Assessment Implementation Procedure:  
<https://www.gs.unsw.edu.au/policy/documents/assessmentimplementationprocedure.pdf>
- Special Consideration: <https://student.unsw.edu.au/special-consideration>