Course Outline

1. Staff

Position	Name	Email	Consultation times and locations	Contact Details
Course Convenor	Prof. Jan Seidel	jan.seidel@unsw.edu.au	Room 340, School of Materials Science and Engineering (Building E10), by appointment	Phone: 9385 4442

2. Course information

Units of credit: 6

Pre-requisite(s): None

Timetabling website: TBA

Teaching times: **lectures are pre-recorded, every Tuesday 9am a live consultation / tutorial / student feedback session will be held using Blackboard (Moodle)**

MATS6008 [illegible]

Week	Tuesday 3-5pm	Thursday 2-4pm
1	Lecture	Lecture / consultation
2	Lecture	Lecture / consultation
3	Lecture	Lecture / consultation
4	Lecture	

Teaching Strategies and Rationale

Key teaching/learning activities in the course include lectures. Lectures will cover core concepts, theories and approaches, which will then be contextualised and consolidated through assignments. Teaching material will utilise real-world key studies in the development of these materials to provide students with an opportunity to identify, evaluate and reflect on the innovative solutions these materials provide worldwide and locally. Where applicable, the course will use online learning technologies to consolidate, support and extend student learning.

Course Learning Outcomes- Make a higher level

1. Compare the key structural elements of particular sub-classes of functional materials that control their behaviour.
2. Apply an understanding of these materials' behaviour to the design of new materials with novel properties
3. Examine the relationships between composition, processing route, microstructure, properties and applications of advanced functional materials.
4. Critique how variations in composition and processing route can lead to the tuning of properties for specific applications.

Assessments

1. Assignment 1 30%
   You will be required to undertake brief essay-style writing and calculations involving the application of modern advanced materials topics covered throughout the course. This assignment will enable you to achieve the desired learning outcomes and develop graduate attributes.

2. Assignment 2 (Lab report) 25%
   You will be required to undertake data analysis and simple calculations involving the concepts and phenomena on modern advanced topics covered throughout the course. This assignment will enable you to achieve the desired learning outcomes and develop graduate attributes.

3. End of Session Examination 45%
   This exam is devoted to all parts of the course consisting of lectures, nominated reading material and assignments and will include, where appropriate, relevant equations. It will consist of a combination of essay-style answers and calculations. (2hrs)

2.1 Course summary

The last few decades have witnessed tremendous growth in functional materials that exhibit novel electronic, thermal, magnetic or ferroelectric behaviours. Such materials underpin advances in a range of fields including information technology, energy storage, catalysis, water purification etc. This includes a range of so-called '2-D' materials such as graphene.

Course content:

- Introduction to advanced functional materials and nanotechnology: definitions and background, a brief history, scales and sizes, size effects, elegant examples from nature and materials science, nanotechnology as business - jobs and products.
- Functional materials applications: 2D, 1D, and 0D - Thin films and interfaces, nanotubes, nanowires and nanoparticles, bio-nanotechnology and medical applications, surface coatings, sensors, energy applications – photovoltaics, batteries, supercapacitors, water splitting, fuel

cells, H2 storage, catalysis, nano-optics - near field optics, plasmonics; nanoelectronics - dimensionality, Coulomb blockade, resonant tunnelling, electron localisation.

- Functional materials characterization: Spectroscopy (UV-VIS-IR, THz, Raman, XRD, XAS, XPS/UPS, EPR/ESR/NMR, RBS, SIMS), Microscopy (SPM, TEM, SEM, …).
- Functional materials synthesis: a brief history of human history and materials, energy and matter - units and terminology, Fabrication techniques: nanolithography/imprint, MBE, PLD, ALD, VLS, sputtering, thermal/e-beam evaporation, CVD, arc synthesis, liquid based synthesis, self-assembly, Langmuir-Blodgett technique.
- lab classes on advanced solar cell materials and advanced scanning probe characterization (KPFM) of such materials

2.2 Expectations of students

- Students must read through lecture notes and lab sheets.
- During class, students are expected to engage actively in class discussions.
- 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.

2.3. Assessment comments

- Unless otherwise specified in the task criteria, all assignments must be handed in to the lecturer prior to or on 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 unable to submit assignments on time or attend the mid-term 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.
- Students who have a disability that requires some adjustment in their tea(.)1(TS(ud)-12(ent)-d ( )Tj -0.00

Final exam: Students will receive their final mark.

2.5. Literature and resources

Preferred textbooks:

- Gateway to Nanotechnology, Sanghera, Paul Infonential, ISBN: 978-1-4392308-7-9

Other s