School of Engineering

MATS6002: Materials Characterisation Techniques

Callaghan
Semester 1 - 2024

COURSE OUTLINE

Welcome to MATS6002 course on Materials Characterization Techniques

OVERVIEW

Course Description

Students will investigate different methods and technologies employed in materials characterisation, including diffraction, microscopy, spectroscopy and chromatography. Each technique will be explored in terms of its applicability and suitability for different characterisation tasks. Students will develop hands-on experience with characterisation equipment, while becoming familiar with safe working practices in a laboratory environment.

Academic Progress Requirements

Nil

Assumed Knowledge

Fundamental knowledge of Physics or Chemistry.

Contact Hours

Callaghan
Lecture
Face to Face On Campus
3 hour(s) per week(s) for 13 week(s) starting Week 1

Tutorial
Face to Face On Campus
1 hour(s) per week(s) for 13 week(s) starting Week 1

Unit Weighting Workload

10
Students are required to spend on average 120-140 hours of effort (contact and non-contact) including assessments per 10 unit course.

CONTACTS

Course Coordinator

Callaghan
Prof Ajayan Vinu
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(02) 4921 8669
Consultation: Consultation by appointment

Teaching Staff

Other teaching staff will be advised on the course Canvas site.

School Office

School of Engineering
EAG03
EA Building
Callaghan
SENG-Admin@newcastle.edu.au
9.00am-1.00pm and 2.00pm-5.00pm (Monday to Friday)

SYLLABUS

Course Content

1. Electron and neutron diffractions
2. Electron microscopy (Scanning electron microscopy (SEM) and transmission electron microscopy (TEM))
3. Spectroscopy (Fourier transformation-infrared spectroscopy, Raman, X-ray photoelectron spectroscopy (XPS), Ultraviolet-visible spectroscopy, Soft and hard X-ray absorption spectroscopy (XAS))
4. Chromatography (Liquid chromatography and gas chromatography)
5. Other analysis technique (Nuclear magnetic resonance (NMR), Thermal gravity analysis-differential scanning calorimetry (TGA-DSC), Inductively coupled plasma mass spectrometry (ICP) and temperature programmed desorption (TPD), etc.)
6. Writing for effective communication and impact

Course Learning Outcomes

On successful completion of this course, students will be able to:

1. Work safely and professionally in a laboratory environment.

2. Explain the scientific principles underpinning technologies and techniques used in nanomaterials characterisation.

3. Plan, organise and deliver a short oral presentation to explain complex information to an audience with low scientific literacy.

4. Apply crystallography, electron microscopy, and spectroscopy techniques for obtaining the phase information, composition and structure of materials.

5. Integrate scientific literature and laboratory findings to select optimal material characterisation equipment for given characterisation problem.

Course Materials

Recommended Reading:

- Liquid Chromatography. 2nd Edition Fundamentals and Instrumentation Fanali, Haddad & Poole
- Applications of neutron powder diffraction KISI
- Handbook of Materials Characterization
- X-ray absorption and X-ray emission spectroscopy,
- Materials Characterization: Introduction to Microscopic and Spectroscopic Methods 2E Yang Leng

SCHEDULE

Week	Week Begins	Topic	Learning Activity	Assessment Due
1	26 Feb	Analysis technique (Nuclear magnetic resonance (NMR), Thermal gravity analysis-differential scanning calorimetry (TGA-DSC),		
2	4 Mar	Analysis techniques (Nuclear magnetic resonance (NMR), Thermal gravity analysis-differential scanning calorimetry (TGA-DSC),		
3	11 Mar	X-ray and electron diffraction		Quiz-1 Professionalism in a laboratory environment
4	18 Mar	X-ray and electron diffraction		Quiz-1 Due
5	25 Mar	Spectroscopy (Fourier transformation-infrared spectroscopy, X-ray photoelectron spectroscopy (XPS),		
6	1 Apr	Raman and Ultraviolet-visible spectroscopy,		Quiz -2 The science of material characterisation technologies
7	8 Apr	Soft and hard X-ray absorption spectroscopy (XAS))		Quiz -2 Due
Mid-Semester Recess				
Mid-Semester Recess				
8	29 Apr	Chromatography (Liquid chromatography and gas chromatography)		
9	6 May	Chromatography (Liquid chromatography and gas chromatography)		Topics for “The guidelines of Equipment Selection, Operation and Characterisation” to be distributed
10	13 May	Inductively coupled plasma mass spectrometry (ICP)		Quiz -3 Quantifying material properties
11	20 May	Temperature programmed desorption (TPD)		Quiz -3 Due
12	27 May	Writing for effective communication and impact		
13	3 Jun	Revision of topics		Written Assignment -The guidelines of Equipment Selection, Operation and Characterisation - submissions due
Examination Period				
Examination Period				

ASSESSMENTS

This course has 4 assessments. Each assessment is described in more detail in the sections below.

	Assessment Name	Due Date	Involvement	Weighting	Learning Outcomes
1	Professionalism in a laboratory environment	18/03/2024	Individual	10%	1
2	The science of material characterisation technologies	08/04/2024	Individual	20%	2, 3
3	Quantifying material properties	20/05/2024	Individual	40%	1, 2, 4
4	The guidelines of Equipment Selection, Operation and Characterisation	03/06/2024	Individual	30%	4, 5

Late Submissions The mark for an assessment item submitted after the designated time on the due date, without an approved extension of time, will be reduced by 10% of the possible maximum mark for that assessment item for each day or part day that the assessment item is late. Note: this applies equally to week and weekend days.

Assessment 1 - Professionalism in a laboratory environment

Assessment Type Quiz
Purpose To measure the students knowledge, skills, and abilities about the laboratory environment
Online
Description Questions will be given to the students regarding the good lab practices, good manufacturing practices and the analytical skills
Weighting 10%
Length 1 h
Due Date 18/03/2024
Submission Method Online
Assessment Criteria After successful completion of this unit, students will be able to work in the materials lab with good analytical skills in a safety manner. The skills of the students will be analysed based on the quiz.
Return Method
Feedback Provided
Opportunity to Reattempt Students WILL NOT be given the opportunity to reattempt this assessment.

Assessment 2 - The science of material characterisation technologies

Assessment Type Presentation
Purpose To assess the students knowledge about the background, theory and application of material characterisation technologies.
Description Students will demonstrate their knowledge and understanding of science behind the material characterisation techniques
Weighting 20%
Length 30 min
Due Date 08/04/2024
Submission Method Online
Assessment Criteria Quality of the presentation, contents, and the knowledge of the topics presented and the overall presentation
Return Method
Feedback Provided
Opportunity to Reattempt Students WILL NOT be given the opportunity to reattempt this assessment.

Assessment 3 - Quantifying material properties

Assessment Type	Tutorial / Laboratory Exercises
Purpose	To know the students ability in the measuring and quantifying of material properties through various characterisation methods
Description	Tutorial/Laboratory exercise will be given to individual student about the application of various characterisation techniques to elucidate the physical and chemical properties of a material
Weighting	40%
Length	1 h
Due Date	20/05/2024
Submission Method	In Class
Assessment Criteria	
Return Method	
Feedback Provided	
Opportunity to Reattempt	Students WILL NOT be given the opportunity to reattempt this assessment.

Assessment 4 - The guidelines of Equipment Selection, Operation and Characterisation

Assessment Type	Written Assignment
Purpose	This is aimed to assess the knowledge gained by the student about the Material Characterisation Techniques
Description	An exam will be given to the student to explain their approach to measure the properties of a material
Weighting	30%
Length	1 h
Due Date	03/06/2024
Submission Method	Online
Assessment Criteria	
Return Method	
Feedback Provided	
Opportunity to Reattempt	Students WILL NOT be given the opportunity to reattempt this assessment.

ADDITIONAL INFORMATION

Grading Scheme

This course is graded as follows:

Range of Marks	Grade	Description
85-100	High Distinction (HD)	Outstanding standard indicating comprehensive knowledge and understanding of the relevant materials; demonstration of an outstanding level of academic achievement; mastery of skills*; and achievement of all assessment objectives.
75-84	Distinction (D)	Excellent standard indicating a very high level of knowledge and understanding of the relevant materials; demonstration of a very high level of academic ability; sound development of skills*; and achievement of all assessment objectives.
65-74	Credit (C)	Good standard indicating a high level of knowledge and understanding of the relevant materials; demonstration of a high level of academic achievement; reasonable development of skills*; and achievement of all learning outcomes.
50-64	Pass (P)	Satisfactory standard indicating an adequate knowledge and understanding of the relevant materials; demonstration of an adequate level of academic achievement; satisfactory development of skills*; and achievement of all learning outcomes.
0-49	Fail (FF)	Failure to satisfactorily achieve learning outcomes. If all compulsory course components are not completed the mark will be zero. A fail grade may also be awarded following

		disciplinary action.

Attendance

*Skills are those identified for the purposes of assessment task(s).
Attendance/participation will be recorded in the following components:

- Lecture (Method of recording: Manual)
- Tutorial (Method of recording: Manual)

Communication Methods

Communication methods used in this course include:

Course Evaluation

Each year feedback is sought from students and other stakeholders about the courses offered in the University for the purposes of identifying areas of excellence and potential improvement.

Oral Interviews (Vivas)

As part of the evaluation process of any assessment item in this course an oral examination (viva) may be conducted. The purpose of the oral examination is to verify the authorship of the material submitted in response to the assessment task. The oral examination will be conducted in accordance with the principles set out in the Oral Examination (viva) Procedure. In cases where the oral examination reveals the assessment item may not be the student's own work the case will be dealt with under the Student Conduct Rule.

Academic Misconduct

All students are required to meet the academic integrity standards of the University. These standards reinforce the importance of integrity and honesty in an academic environment. Academic Integrity policies apply to all students of the University in all modes of study and in all locations. For the Student Academic Integrity Policy, refer to https://policies.newcastle.edu.au/document/view-current.php?id=35.

Adverse Circumstances

The University acknowledges the right of students to seek consideration for the impact of allowable adverse circumstances that may affect their performance in assessment item(s).
Applications for special consideration due to adverse circumstances will be made using the online Adverse Circumstances system where:

1. the assessment item is a major assessment item; or
2. the assessment item is a minor assessment item and the Course Co-ordinator has specified in the Course Outline that students may apply the online Adverse Circumstances system;
3. you are requesting a change of placement; or
4. the course has a compulsory attendance requirement.

Before applying you must refer to the Adverse Circumstance Affecting Assessment Items Procedure available at:
https://policies.newcastle.edu.au/document/view-current.php?id=236

Important Policy Information

The Help button in the Canvas Navigation menu contains helpful information for using the Learning Management System. Students should familiarise themselves with the policies and procedures at https://www.newcastle.edu.au/current-students/respect-at-uni/policies-and-procedures that support a safe and respectful environment at the University.

Graduate Profile Statements

This course builds students' capacity in the following University of Newcastle Bachelor of Engineering Graduate Profile Statements (based on 2011 Engineers Australia revised Stage 1 Competency Standards for Professional Engineers):

UON Att.	University of Newcastle Bachelor of Engineering Graduate Profile Statements/ Engineers Australia Stage 1 competency statements	Taught	Practised	Assessed	Skill Level (1-4)
	Professional Attributes				
11	3.1. Ethical conduct and professional accountability	O			1
12	3.2. Effective oral and written communication in professional and lay domains.	O			3
13	3.3. Creative, innovative and pro-active demeanour.	O			4
14	3.4. Professional use and management of information.		O		2
15	3.5. Orderly management of self, and professional conduct.	O			3
16	3.6. Effective team membership and team leadership.	O			4
	Engineering Ability				
7	2.1. Application of established engineering methods to complex engineering problem solving.		O		2
8	2.2. Fluent application of engineering techniques, tools and resources.		O		3
9	2.3. Application of systematic engineering synthesis and design processes.		O		2
10	2.4. Application of systematic approaches to the conduct and management of engineering projects.	O			2
	Knowledge Base				
1	1.1. Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline.			O	3
2	1.2. Conceptual understanding of the, mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline.			O	2
3	1.3. In-depth understanding of specialist bodies of knowledge within the engineering discipline.		O		2
4	1.4. Discernment of knowledge development and research directions within the engineering discipline.	O			3
5	1.5. Knowledge of contextual factors impacting the engineering discipline.			O	3
6	1.6. Understanding of the scope, principles, norms, accountabilities and bounds of contemporary engineering practice in the specific discipline.			O	4

This course outline was approved 1/02/2024 by the Head of School. No alteration of this course outline is permitted without Head of School approval. If a change is approved, students will be notified and an amended course outline will be provided in the same manner as the original.