

## CHEM3110: Instrumental Chemical Analysis

Callaghan

Semester 1 - 2024



THE UNIVERSITY OF  
NEWCASTLE  
AUSTRALIA

## OVERVIEW

**Course Description** Chemical instrumentation is important in providing experimental data necessary for basic research and applications in analytical, environmental, organic, medicinal and advanced materials chemistry. Instrumentation fills only part of the need, as the challenges presented often require highly developed skills and judgement of the experimenter in order to obtain the most reliable results. This course provides the conceptual knowledge, experience and skills related to a variety of instrumental analytical and separation techniques suitable for materials in complex matrices and interfaces. Building on the foundations provided in CHEM2110, this course introduces students to advanced instrumentation and analytical skills.

**Academic Progress Requirements** Nil

**Requisites** Students must have successfully completed CHEM2110 or CHEM2201 to enrol in this course.

**Contact Hours**

**Callaghan Laboratory \***  
Face to Face On Campus  
3 hour(s) per week(s) for 13 week(s) starting Week 1  
Laboratory and Workshops

**Lecture**  
Face to Face On Campus  
2 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** \* This contact type has a compulsory requirement.  
10  
Students are required to spend on average 120-140 hours of effort (contact and non-contact) including assessments per 10 unit course.

# COURSE OUTLINE

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# CONTACTS

<b>Course Coordinator</b>	<b>Callaghan</b> Prof Scott Donne <a href="mailto:Scott.Donne@newcastle.edu.au">Scott.Donne@newcastle.edu.au</a> (02) 4921 5477 Consultation: By email or by appointment.
<b>Teaching Staff</b>	Dr. Sam Chen ( <a href="mailto:sam.chen@newcastle.edu.au">sam.chen@newcastle.edu.au</a> ) Dr. Thomas Fallon ( <a href="mailto:thomas.fallon@newcastle.edu.au">thomas.fallon@newcastle.edu.au</a> ) Prof. Erica Wanless ( <a href="mailto:erica.wanless@newcastle.edu.au">erica.wanless@newcastle.edu.au</a> ) Dr. Glenn Bryant ( <a href="mailto:glenn.bryant@newcastle.edu.au">glenn.bryant@newcastle.edu.au</a> )
<b>School Office</b>	Consultation: By appointment <b>School of Environmental and Life Sciences</b> Room C228 Chemistry Building Callaghan <a href="mailto:Science-SELS@newcastle.edu.au">Science-SELS@newcastle.edu.au</a> +61 2 4921 5080 9am-5pm (Mon-Fri)

# SYLLABUS

<b>Course Content</b>	The course includes the following topics: <ol style="list-style-type: none"><li>1. Atomic absorption and emission spectroscopy</li><li>2. Vibrational spectroscopy (FT-IR, Raman)</li><li>3. Heteronuclear NMR, Solid-state NMR</li><li>4. Mass spectrometry</li><li>5. X-ray scattering, spectroscopy and imaging</li><li>6. Interfacial studies: analysis of solid interfaces</li><li>7. Thermal methods (Thermogravimetric and differential thermal analysis)</li><li>8. Chromatography: Gas, Liquid (various modes) and supercritical fluid</li><li>9. Capillary Electrophoresis</li><li>10. Electrochemical methods of analysis</li><li>11. Advanced electron microscopy</li></ol>
<b>Course Learning Outcomes</b>	<b>On successful completion of this course, students will be able to:</b> <ol style="list-style-type: none"><li>1. Explain the theoretical principles underpinning the instrumental techniques and their applications;</li><li>2. Assess the appropriateness of the instrumental methods for the analysis of samples in various formats and from complex matrices;</li><li>3. Acquire practical analytical skills and employ a variety of instrumental techniques for the analysis of samples in various formats and from various matrices;</li><li>4. Analyse and present experimental results and draw sound conclusions based on experimental evidence;</li><li>5. Work safely and competently in an analytical laboratory setting;</li><li>6. Contribute to team and group work for scientific investigation and reporting;</li><li>7. Independently integrate concepts and techniques in instrumental analysis and correlate to relevant applications.</li></ol>

# COMPULSORY REQUIREMENTS

In order to pass this course, each student must complete ALL of the following compulsory requirements:

## Contact Hour Requirements:

- Laboratory Attend 90% of sessions

## Course Assessment Requirements:

- Assessment 1 - Workshop and Laboratory Exercises and Reports: Pass requirement - Must pass this assessment item to pass the course.

# SCHEDULE

Week	Week Begins	Topic	Learning Activity	Assessment Due
1	26 Feb	Electrochemical methods (SD)	Lectures, tutorial and laboratory (SD)	Lab induction
2	4 Mar	Electrochemical methods (SD)	Lectures, tutorial and laboratory (SD)	Lab report (SD)
3	11 Mar	Electrochemical methods (SD)	Lectures, tutorial and laboratory (SD)	Lab report (SD)
4	18 Mar	Atomic spectroscopy: Absorption and emission (SC)	Lectures, tutorial and laboratory (SC)	Section assessment (SD)
5	25 Mar	Vibrational spectroscopy (SC)	Lectures, tutorial and laboratory	Lab report (SC)
6	1 Apr	Easter Monday -- no lectures or tutorial	Laboratory (SC)	Lab report (SC)
7	8 Apr	Thermal analysis (SC) Interfacial studies (EW)	Lectures (SC), tutorial (SC) and workshop (EW)	Lab report (SC)
<b>Mid-Semester Recess</b>				
<b>Mid-Semester Recess</b>				
8	29 Apr	Interfacial studies (EW)	Lectures, tutorial and workshop (EW)	Section assessment (SC)
9	6 May	Interfacial studies (EW) NMR methods (TF)	Lectures (EW), tutorial (EW) and workshop (TF)	Workshop report (EW)
10	13 May	NMR methods (TF)	Lectures, tutorial and workshop (TF)	Section assessment (EW)
11	20 May	NMR methods (TF) Mass spectrometry (GB)	Lectures (TF), tutorial (TF) and workshop (GB)	Workshop report (TF)
12	27 May	Mass spectrometry (GB)	Lectures, tutorial and workshop (GB)	Section assessment (TF)
13	3 Jun	Mass spectrometry (GB)	Lectures and tutorial	Workshop report (GB)
<b>Examination Period</b>				Section assessment (GB)
<b>Examination Period</b>				

# ASSESSMENTS

This course has 2 assessments. Each assessment is described in more detail in the sections below.

	Assessment Name	Due Date	Involvement	Weighting	Learning Outcomes
1	Workshop and Laboratory Exercises and Reports*	One week after completion of experiment or workshop.	Combination	40%	2, 3, 4, 5, 6
2	In-class Quiz or Assignment/Homework	Assessments (either quiz or assignment) will occur at the conclusion of each module.	Individual	60%	1, 2, 7

\* This assessment has a compulsory requirement.

**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 - Workshop and Laboratory Exercises and Reports

<b>Assessment Type</b>	Report
<b>Purpose</b>	Laboratory exercises develop laboratory skills, professional and safety responsibilities of students. Written lab reports help students develop their skills in acquisition and interpretation of data and production of articulate and concise documents which convey evidence-based understanding of the concepts and topics. Group activities are designed for students to learn to work in a team. Workshops supplement theoretical concepts in instrumentation and data analysis of material characterization techniques which could not be represented by practical exercises.
<b>Description</b>	Lab exercises are scheduled from Weeks 1-6, workshops on Weeks 7-12. Lab reports will be submitted as a group, whilst the workshop reports/assessments (3) will be individual.
<b>Weighting</b>	40%
<b>Compulsory Requirements</b>	Pass requirement - Must pass this assessment item to pass the course.
<b>Length</b>	As required.
<b>Due Date</b>	One week after completion of experiment or workshop.
<b>Submission Method</b>	Specific Location Lab reports and workshop assessments should be submitted in the designated submission box outside SB209 or given directly to the lab demonstrator, unless otherwise instructed by lecturers.
<b>Assessment Criteria</b>	Lab reports: details are given in the lab manual. For workshop report/assessment: assigned marks will be provided on the worksheet and/or Canvas.
<b>Return Method</b>	In Class
<b>Feedback Provided</b>	Returned Work - Two weeks after submission. Verbal feedback will be provided if necessary.
<b>Opportunity to Reattempt</b>	Students WILL be given the opportunity to reattempt this assessment.

## Assessment 2 - In-class Quiz or Assignment/Homework

<b>Assessment Type</b>	Written Assignment
<b>Purpose</b>	The purpose is to provide the students with regular feedback and revision opportunities. These tests/assessments highlight areas of concern and may stimulate discussion with lecturers.
<b>Description</b>	This assessment could be in the form of a take-home assignment or an in-class test and given by each lecturer contributing to the course at the end of each module.
<b>Weighting</b>	60%
<b>Due Date</b>	Assessments (either quiz or assignment) will occur at the conclusion of each module.
<b>Submission Method</b>	Specific Location These will be specified by each lecturer - check Canvas for announcements. They will be either in class/online for quizzes; designated box outside SB209 or online via Canvas for assignments.
<b>Assessment Criteria</b>	Assigned marks will be provided either on the questionnaire/worksheet or via Canvas.
<b>Return Method</b>	
<b>Feedback Provided</b>	In Class - Either in class, in person, or online. Returned work - Two weeks after submission. Verbal feedback will be provided if necessary.

## 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.

\*Skills are those identified for the purposes of assessment task(s).

### Communication Methods

Communication methods used in this course include:

- Canvas Course Site: Students will receive communications via the posting of content or announcements on the Canvas course site.
- Email: Students will receive communications via their student email account.
- Face to Face: Communication will be provided via face to face meetings or supervision.

### 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.

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**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.

*This course outline was approved 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.*

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