

CHEM2110: Applied Analytical Chemistry

Callaghan

Semester 1 - 2024



THE UNIVERSITY OF
NEWCASTLE
AUSTRALIA

OVERVIEW

Course Description

The aim of this course is to provide students with a broad understanding of the principles of analytical chemistry and their application in the areas of environmental and medicinal/pharmaceutical sciences and advanced materials. Depending on their program, students will have the opportunity to apply analytical chemical methods in any one of the following areas:

1. Environmental Sciences: Students apply analytical techniques to study the chemical processes that form the basis for the operation of the three spheres of the natural environment (atmosphere, geosphere, hydrosphere), and the changes brought about by human activities and broad environmental factors (e.g. climate).

2. Medicinal/Pharmaceutical Sciences: Students are introduced to the fundamental instrumental methods of chemical analysis commonly used in pharmaceutical laboratories. The laboratory introduces the students to practical skills on the separation, purification and quantitation of pharmaceutically relevant compounds.

3. Advanced Materials: Students are introduced to the fundamental analytical techniques that are useful for the purification and characterisation of advanced materials. Students will be given the opportunity to further apply these methodologies to more specific groups of advanced materials in other courses within the BSc Chemistry (Advanced Materials) program.

This course will provide lectures for all students focusing on analytical methods and the underlying theoretical principles. Lectorials and laboratories will extend the lecture with emphasis on applications on any of the above-mentioned areas.

Students will be streamed in lectorials and labs according to their program or major or interest (in the case of those taking the course as an elective).

Academic Progress Requirements

Nil

COURSE OUTLINE

www.newcastle.edu.au

CRICOS Provider 00109J

Assumed Knowledge	CHEM1010, CHEM1020 and ENV51002.
Contact Hours	Callaghan Laboratory Face to Face On Campus 3 hour(s) per week(s) for 13 week(s) starting Week 1 Lecture Face to Face On Campus 3 hour(s) per week(s) for 3 week(s) starting Week 1 Lectorial Face to Face On Campus 3 hour(s) per week(s) for 9 week(s) starting Week 4
Unit Weighting	10
Workload	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 Dr Sam Chen Sam.Chen@newcastle.edu.au Consultation: By appointment through email
Teaching Staff	Prof Alister Page (AP) Alister.Page@newcastle.edu.au 40339357 C222 Chemistry Building Dr Glenn Bryant (GB) glenn.bryant@newcastle.edu.au C216b Chemistry Building Prof Scott Donne (SD) scott.donne@newcastle.edu.au (02) 4921 5477 NIER C Block Room C-111 Prof Erica Wanless (EW) erica.wanless@newcastle.edu.au (02) 4033 9355 C217 Chemistry Building Dr Thomas Fallon (TF) thomas.fallon@newcastle.edu.au C216 Chemistry Building Dr Qianqian Shi (QS) Qianqian.Shi@newcastle.edu.au C216 Chemistry Building
School Office	School of Environmental and Life Sciences Room C228 Chemistry Building Callaghan Science-SELS@newcastle.edu.au +61 2 4921 5080 9am-5pm (Mon-Fri)

SYLLABUS

Course Content

The following content will be delivered within the context of either environmental science, medicinal/pharmaceutical science or advanced materials.

1. Sampling and Sample Preparation
2. Data Treatment
3. Chemical (acid-base, complex, precipitation and redox) Equilibria and Volumetric Analysis
4. Electroanalytical Methods
5. Spectrophotometry: fundamentals and applications
6. Atomic Spectroscopy: absorption, emission
7. Separation Methods: precipitation, solvent extraction, ion-exchange, chromatography, electrophoresis

Course Learning Outcomes

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

1. Describe and compare a range of analytical chemistry methods and explain the underlying theoretical principles;
2. Explain the broad role of analysts in quality control and assessment of experimental measurements from various application contexts;
3. Employ a variety of analytical methods to prepare, separate and characterise samples from various matrices;
4. As part of a team or individually, conduct, analyse and interpret results of a chemical analysis and effectively communicate these in written reports and other formats;
5. Work safely and competently in an analytical laboratory setting.

COMPULSORY REQUIREMENTS

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

Contact Hour Requirements:

- Laboratory Induction Requirement - Students must attend and pass the induction requirements before attending these sessions.

Course Assessment Requirements:

- Assessment 1 - Formal Examination: Minimum Grade / Mark Requirement - Students must obtain a specified minimum grade / mark in this assessment item to pass the course. Students must obtain a minimum passing grade of 40% in the final, end-of-semester examination for the course.
- Assessment 3 - Workshop / Laboratory Exercises: Pass Requirement - Students must pass this assessment item to pass the course. Students must participate in and submit all 7 laboratory reports for the established minimum requirements and obtain a minimum passing grade of 50%.

Students may only miss 1 session of the following: data analysis workshops (Weeks 2-4), and 'wet' and 'dry' laboratory sessions (Weeks 5-13).

SCHEDULE

Week	Week Begins	Stream A Learning Activity	Stream B Learning Activity	Assessment Due
1	26 Feb	Introduction to Quantitative Analysis (AP)	Introduction to Quantitative Analysis (AP) Lab induction and exercise	Compulsory Lab Induction
2	4 Mar	Fundamentals of Data Analysis in Chemistry (AP) Workshop 1	Fundamentals of Data Analysis in Chemistry (AP) Workshop 1	
3	11 Mar	Statistical Treatments of Data in Chemistry (AP) Workshop 2	Statistical Treatments of Data in Chemistry (AP) Workshop 2	Workshop 1 report
4	18 Mar	Chemical equilibrium, reaction quotient, equilibrium constant, Gravimetric analysis (SC) Workshop 3	Geosphere: The rock cycle, soil formation and composition (GB) Workshop 3	Workshop 2 report.
5	25 Mar	Titration, endpoint detection, standardisation, acid-base titration, titration of strong acids and bases (SC) Wet laboratory 1	Geosphere: Soil chemistry (GB) Wet laboratory 1	Lecture Quiz Workshop 3 report.
6	1 Apr	No lectorials No labs	No lectorials No labs	
7	8 Apr	Titration of weak acids and bases, buffers, indicators, complexometric titration (SC) Dry laboratory 1	Geosphere: Anthropogenic changes (GB) Dry laboratory 1	
Mid-Semester Recess				
Mid-Semester Recess				
8	29 Apr	Beer-Lambert Law; Applications of spectrophotometry (SD) Wet laboratory 2	Hydrosphere: Introduction; Species Distribution (EW) Wet laboratory 2	Lectorial assignment 1 Laboratory 1 report.
9	6 May	Absorption, Emission and Fluorescence methods; ICP; Electrochemical Methods (SD) Dry laboratory 2	Hydrosphere: Species Distribution; Gases in water (EW) Dry laboratory 2	
10	13 May	Reference electrodes; Redox titrations; Common redox systems; Potentiometry; Polarography; Cyclic voltammetry (SD) Wet laboratory 3	Hydrosphere: Organic matter in water; Metals in the hydrosphere; Microbial processes in the environment (EW) Wet laboratory 3	Laboratory 2 report
11	20 May	Applications of Solvent Extraction and Ion-exchange (TF) Dry laboratory 3	Atmosphere: Atmospheric structure and units; Molecules of the stratosphere and their sources (QS) Dry laboratory 3	Lectorial assignment 2
12	27 May	Applications of Solvent Extraction	Atmosphere: Molecules of the	Laboratory 3 report

		and Ion-exchange; Chromatographic Parameters and Separation Efficiency (TF)	troposphere and their sources (QS)	
		Wet laboratory 4	Wet laboratory 4	
13	3 Jun	Applications of GC and HPLC Analysis, Method Optimisation, Electrophoretic separations and quantitative analysis (TF)	Atmosphere: Greenhouse gases and their quantitation (QS)	
		Dry laboratory 4	Dry laboratory 4	
14	10 Jun	Examination Period		Lectorial assignment 3
				Laboratory 4 report
Examination Period				

ASSESSMENTS

This course has 3 assessments. Each assessment is described in more detail in the sections below.

	Assessment Name	Due Date	Involvement	Weighting	Learning Outcomes
1	Formal examination*	During exam period	Individual	30%	1, 2, 3
2	Written assignment or In-Class Test	Lecture quiz in Week 5; lectorial assignment in Weeks 8, 11 and 14.	Individual	30%	2, 3
3	Laboratory Exercises and Reports*	Workshop/Laboratory reports in Weeks 3, 4, 5, 8, 10, 12 and 14	Combination	40%	1, 2, 3, 4, 5

* 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 - Formal examination

Assessment Type

Formal Examination

Description

The final exam will cover lectorial materials. Expect various types of questions that may require numerical or non-numerical answers, short answers or essay-type questions.

Weighting

30%

Compulsory Requirements

Pass requirement 40% - Must obtain 40% in this assessment item to pass the course.

Due Date

During exam period

Submission Method

Formal Exam. Format of exam, i.e. online or face to face, to be confirmed.

Assessment Criteria

The marking distribution is provided in the exam script. Full marks are awarded to satisfactory (non-numerical) and correct (numerical) answers, partial marks may be awarded to partially correct answers depending on the question and at the discretion of the marker.

Return Method

Not Returned

Feedback Provided

No Feedback - See the Course Coordinator

Opportunity to Reattempt

Students WILL be given the opportunity to reattempt this assessment.

Students who obtain less than 40% in the final exam but passing overall will be given the opportunity to reattempt. If the student passes the re-attempt, then the mark will be capped at 40%.

Assessment 2 - Written assignment or In-Class Test

Assessment Type	Written Assignment
Description	This assessment is divided into 2 parts: lecture (15%) and lectorial assessments (15%). The lecture assessment is in the form of a face-to-face quiz given in Week 5 while the lectorial assessments could be in the form of either a quiz or written assignment due in Weeks 8, 11 and 14.
Weighting	30%
Due Date	Lecture quiz in Week 5; lectorial assignment in Weeks 8, 11 and 14.
Submission Method	Assignment Boxes Online Submission method to be confirmed by the lecturer.
Assessment Criteria	Assessment criteria and marking distribution will be provided with the assignment. Marking distribution will be given under instructions visible to the students before commencement of a test.
Return Method	In Person Online
Feedback Provided	Returned Work - Within 3 weeks of submission. Can be written in returned assignment; specific feedback for each online questions or general feedback provided to the class via Canvas site or email.
Assessment Type	Written Assignment

Assessment 3 – Workshop/Laboratory Exercises and Reports

Assessment Type	Workshop / Laboratory Exercises
Description	<ul style="list-style-type: none">• Week 1 is a compulsory lab induction and to complete an Exercise on Analytical Measurements that aims to introduce students to basic analytical apparatus and glassware, their use and operation.• Weeks 2-4 are computer-based workshops which include data analysis and presentation using Excel, generation of calibration curves, and statistical analysis / linear regression.• Weeks 5, 8, 10, 12 are laboratory exercises ('wet' labs) including performing experiments to develop students' appropriate laboratory skills and professional and safety responsibilities. Group work is designed for students to learn to work in a team.• Weeks 6, 9, 11, 13 are data processing exercises ('dry' labs) to develop students' skills in the interpretation of data acquired from the previous 'wet' labs and production of articulate and concise written lab reports which convey evidence-based understanding of the concepts and topics.
Weighting	40% in total. Each workshop report has a weighting of ~3.6%; each experimental report has a weighting of ~7.3%.
Compulsory Requirements	Pass Requirement - Students must pass this assessment item to pass the course. Students must participate in and submit all 7 laboratory reports and obtain a minimum passing grade of 50%. Students may only miss 1 laboratory session.
Due Date	Laboratory reports in Weeks 3, 4, 5, 8, 10, 12 and 14, as detailed in Schedule.
Submission Method	Assignment Boxes In Class Online Hardcopies of the reports to be submitted in-class or in the submission box provided.
Assessment Criteria	Refer to laboratory manual for the marking criteria for each experiment.
Return Method	In Class
Feedback Provided	Returned Work - Within 2 weeks of submission. Can be written in returned report; specific feedback provided to the student or general feedback provided to the class.
Opportunity to Reattempt	Students WILL be given the opportunity to reattempt this assessment. Students with a valid adverse circumstance will be given the opportunity to re-attempt.

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).

Attendance

Attendance/participation will be recorded in the following components:

- Laboratory (Method of recording: Roll call, manual recording of attendance.)

Students who arrive 15 minutes after lab commencement will not be allowed to participate in the lab activity particularly if the student comes after the safety talk.

Students may only miss 1 laboratory session. Students with evidence of adverse circumstances who will not meet the lab compulsory requirements will be given the chance to make up for missed experiments during the semester. Students must make arrangements with the Course Coordinator in order to be given this opportunity.

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.

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

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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