School of Environmental and Life Sciences

CHEM3580: Colloids, Interfaces and Soft Matter

Callaghan
Semester 1 - 2024

COURSE OUTLINE

OVERVIEW

Course Description

This course introduces students to colloid and interface science. Key surface chemistry concepts are introduced, including the role of surface energy and adsorption of molecules at phase boundaries or interfaces. In introducing colloidal materials, emphasis is placed on the methods of their preparation and structure-property relationships. Dissolved polymers are ubiquitous in everyday formulations and thus the behaviour of polymers in solution is investigated. The self-assembly of amphiphiles into soft materials including micelles, liquid crystals and microemulsions is examined, and the relationship between these structures and formulations in which they are used is explained. The laboratory component provides training in techniques which are specific to the preparation, characterisation and simulation of dilute and concentrated surfactant and polymer solutions, and colloidal dispersions. Throughout the course, the relationship between the structure and properties of the materials and their performance in household, environmental and industrial applications will be highlighted.

Academic Progress Requirements

Nil

Requisites

To enrol in this course students must have successfully completed CHEM2210 and CHEM2410.

Students who have completed either CHEM2410 or CHEM2210 together with CHEM2310 prior to 2022 should email CESE-SELS@newcastle.edu.au to enrol in CHEM3580.

Assumed Knowledge

CHEM2210 Materials Chemistry
CHEM2410 Physical Chemistry

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 13 week(s) starting Week 1

* This contact type has a compulsory requirement.

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 Erica Wanless
Erica.Wanless@newcastle.edu.au
(02) 4033 9355
Consultation: Consultation: By email appointment - room C217 Chemistry Building

Teaching Staff

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

School Office

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9am-5pm (Mon-Fri)

SYLLABUS

Course Content

Chemistry of Interfaces - surface energy, adsorption, the solid-gas interface, the solid-liquid interface, the liquid-gas interface.
Colloid Chemistry - classification and preparation of colloidal materials, theory and control of colloid stability.
Simulating Interfaces - atomistic molecular dynamics, course-grained models.
Polymer Solutions - thermodynamics of polymer dissolution, polymer conformation and size in solution.
Polymer and Colloid Characterisation - characterisation of polymer solutions and colloidal dispersions – size, shape and structural analysis.
Soft Matter - surfactant self-assembly lyotropic liquid crystals, structured gels and particles, formulations and applications

Course Learning Outcomes

On successful completion of this course, students will be able to:
1. Relate the structure and properties of surface active and polymer molecules, and colloidal materials to their performance and intended applications;

2. Describe the different approaches to the classification and preparation of colloidal materials and soft matter;

3. Describe the use of surface-active, soft matter and colloidal materials in household, industrial and environmental applications;

4. Demonstrate competence in the use of various procedures and instruments for the synthesis and/or characterisation of surface-active molecules, soft matter and colloidal materials;

5. Apply the scientific process in the conduct and reporting of experimental investigation;

6. Demonstrate an awareness of the safety responsibilities involved in working with chemicals and hazardous substances.

Course Materials

Recommended Reading:

- D.J. Shaw, Introduction to Colloid and Surface Chemistry, Butterworths, 4th Ed., 1992.
- T. Cosgrove (Ed.), Colloid Science: Principles, Methods and Applications, Blackwell, 2005.
- D. Fennell Evans & H. Wennerström, The Colloidal Domain: Where Physics, Chemistry, Biology and Technology Meet, VCH Publishers, 1994.
- Barnes, G.T., Gentle, I.R., Interfacial Science: an Introduction, Oxford University Press, 2011.
- Adamson, A.W., Gast A.P., Physical Chemistry of Surfaces, 6th Edition, Wiley, 1997.
- Jensen, F., Introduction to Computational Chemistry, 2 Edition, Wiley, 2013.
- Cramer, C., Essentials of Computational Chemistry: Theories and Models, 2 Edition, Wiley, 2004.

COMPULSORY REQUIREMENTS

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

Contact Hour Requirements:

- Laboratory Has compulsory attendance

Course Assessment Requirements:

- Assessment 1 - Laboratory Exercises and Reports: Pass requirement - Must pass this assessment item to pass the course.
- Assessment 2 - In Term Tests: Pass requirement 40% - Must obtain 40% in this assessment item to pass the course.

SCHEDULE

Week	Week Begins	Topic	Learning Activity	Assessment Due
1	26 Feb	Chemistry of Interfaces - surface energy, adsorption (EW)	Lectures and Labs	
2	4 Mar	Chemistry of Interfaces - adsorption, the liquid-gas interface (EW)	Lectures and Labs	Homework 1 (5%, EW)
3	11 Mar	Chemistry of Interfaces - the solid-gas interface, the solid-liquid interface (EW)	Lectures and Labs	Homework 2 (5%, EW) Lab report 1 (5.5%, EW)
4	18 Mar	Colloid Chemistry - classification and fundamentals of colloidal materials (EW)	Lectures and Labs	Homework 3 (5%, EW)
5	25 Mar	Colloid Chemistry - theory and control of colloid stability (EW)	Lectures (Tuesday only) and Labs	Homework 4 (5%, EW) Lab report 2 (presentation, 5.5%, EW)
6	1 Apr	Particle synthesis including size & shape control (QS)	Lecture (Friday only) and Labs	Homework 5 (5%, EW)
7	8 Apr	Particle synthesis including size & shape control (QS)	Lectures and Labs	Homework 6 (5%, QS)
Mid-Semester Recess				
Mid-Semester Recess				
8	29 Apr	Characterisation of polymer solutions and colloidal dispersions – size, shape and structural analysis (QS)	Lectures and Labs	Homework 7 (5%, QS) Lab report 3 (5.5%, QS)

9	6 May	Characterisation of polymer solutions and colloidal dispersions – size, shape and structural analysis (QS)	Lectures and Labs	Homework 8 (5%, QS)
10	13 May	Simulating condensed phases and interfaces - atomistic molecular dynamics (AP)	Lectures and Labs	Homework 9 (5%, QS) Lab report 4 (5.5%, QS)
11	20 May	Simulating condensed phases and interfaces - atomistic molecular dynamics (AP)	Lectures and Labs	Homework 10 (5%, AP) Lab report 5 (2.7%, AP)
12	27 May	Simulating condensed matter and interfaces - atomistic molecular dynamics (AP)	Lectures and Labs	Homework 11 (5%, AP) Lab report 6 (2.7%, AP)
13	3 Jun			Homework 12 (5%, AP) Lab report 7 (2.6%, AP) Presentation at Chemistry level 3000 showcase on 7 June (5%)
Examination Period				
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	Laboratory Exercises and Reports*	One week after the last laboratory session for each experiment.	Individual	30%	1, 2, 3, 4, 5, 6
2	In Term Tests*	Weekly from weeks 2-13.	Individual	60%	1, 2, 3
3	Oral Presentation	Draft slides due on Canvas in Week 11. Presentation during Undergraduate Chemistry showcase on Friday of Week 13.	Individual	10%	1, 2, 3, 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 - Laboratory Exercises and Reports

Assessment Type Tutorial / Laboratory Exercises
Purpose Report in the prescribed format describing the activities, outcomes and conclusions from each experiment undertaken.
Description The report format is described in the course laboratory manual. Interfaces & colloids lab reports 1-4: 5.5% each, Computational interfaces reports 8% total.
Weighting 30%
Compulsory Requirements Pass requirement - Must pass this assessment item to pass the course.
Length As advised in class/Canvas.
Due Date One week after the last laboratory session for each experiment.
Submission Method Assignment Boxes
In Class
Online

	Physical copies of Experiments 1,3 &4 with cover sheets are to be submitted in the appropriate report box outside the laboratory. Presentation of Lab report 2 in class. Computational reports (weeks 11-13) to be submitted via Canvas.
Assessment Criteria	Practical & computational laboratory work is the central component of chemistry by which knowledge is advanced, and the means by which professional chemists contribute to an understanding of real-world problems. Assessment of performance in the laboratory course, the quality of results and observational skills, and the ability to explain results together with the related theoretical background should stimulate discussion with demonstrators, lecturers and fellow students.
Return Method	In Class Online
Feedback Provided	Returned Work - Returned Work - Two weeks after submission of report. Feedback will be written on marked report.
Opportunity to Reattempt	Students WILL be given the opportunity to reattempt this assessment.

Assessment 2 - In Term Tests

Assessment Type	In Term Test
Purpose	Lecture assessment designed to embed skills associated with each section of the course. Mixture of descriptive questions and calculations as appropriate.
Description	The format of these weekly assessment items will vary from textual responses to Excel exercises to Canvas quizzes. Weekly 5% homework.
Weighting	60%
Compulsory Requirements	Pass requirement 40% - Must obtain 40% in this assessment item to pass the course.
Length	As advised in class/Canvas.
Due Date	Weekly from weeks 2-13.
Submission Method	Online Canvas upload or Quiz
Assessment Criteria	Written homework meets the course objectives of knowledge acquisition and demonstrated assimilation of data, upon reflection and analysis, to produce articulate and concise documents which convey evidence-based understanding of the concepts and topics.
Return Method	Online
Feedback Provided	Online - Online - Two weeks after submission. Feedback will be written on uploaded assessment item.
Opportunity to Reattempt	Students WILL be given the opportunity to reattempt this assessment.

Assessment 3 - Oral Presentation

Assessment Type	Presentation
Purpose	To probe more deeply into the course through research a topic of interest to more than one of the lecture sections. Topics will be assigned to groups.
Description	A short group presentation on an assigned topic.
Weighting	10%
Length	As advised in class/Canvas.
Due Date	Draft slides due on Canvas in Week 11. Presentation during Undergraduate Chemistry showcase on Friday of Week 13.
Submission Method	In Class Online Draft slides to be uploaded to Canvas for assessment.
Assessment Criteria	The purpose and benefit of oral presentations is to develop oral communication skills, synthesise an opinion and convey this clearly in a well-presented and articulate manner.
Return Method	In Class Online
Feedback Provided	Online - Written feedback on draft slides. In class feedback on oral presentation.
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.

*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: Students to complete the laboratory induction in week 1 prior to starting laboratory work. Students to sign the laboratory attendance register each week. Students must participate in and submit laboratory reports for the established minimum requirements.)

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.

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.