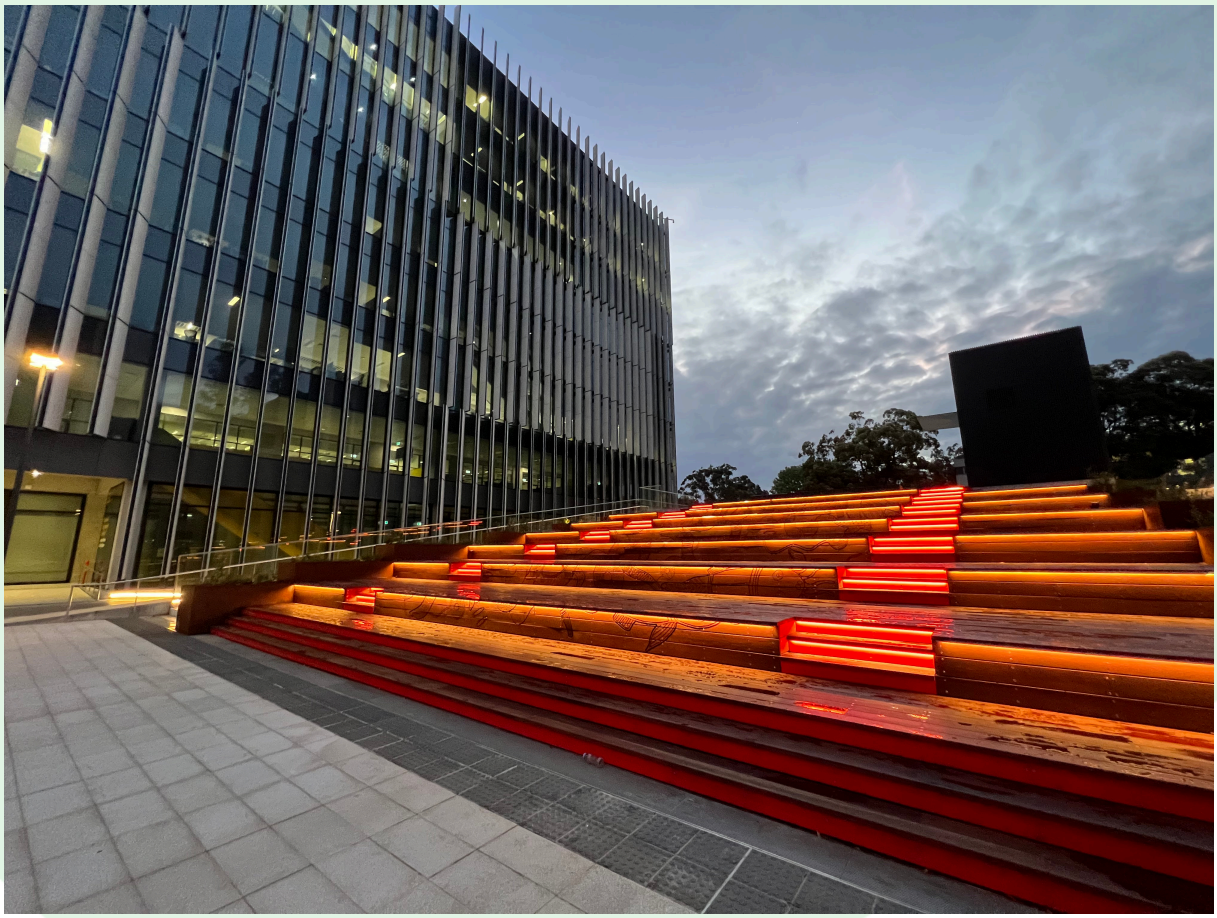
School of Chemical Engineering

UNSW Engineering

CEIC6711

Complex Fluids Microstructure and Rheology

Term 1, 2022



Course Overview

Staff Contact Details

Convenors

Name	Email	Availability	Location	Phone
Patrick Spicer	p.spicer@unsw.edu.au		318 Hilmer	

Lecturers

Name	Email	Availability	Location	Phone
Stuart Prescott	s.prescott@unsw.edu.au		316A Hilmer	

School Contact Information

For assistance with enrolment, class registration, progression checks and other administrative matters, please see the Nucleus: Student Hub. They are located inside the Library – first right as you enter the main library entrance. You can also contact them via http://unsw.to/webforms or reserve a place in the face-to-face queue using the UniVerse app.

If circumstances outside your control impact on submitting assessments, Special Consideration may be granted, usually in the form of an extension or a supplementary assessment. Applications for Special Consideration must be submitted online.

For course administration matters, please contact the Course Coordinator.

Course Details

Units of Credit 6

Summary of the Course

The link between molecules and the macroscopic properties we measure depends on the microscale and mesoscale structures the molecules form in complex fluids like emulsions, foams, aerosols, and particle dispersions. Study of complex fluids encompasses many applications: Food formulation and processing, Pharmaceutical development and testing, and Specialty Fluid Chemical Products. Complex fluid structures interact at the mesoscale to impart properties such as texture, viscosity, colour, taste, and feel. This course covers the structures that molecules can form, why interfaces are so important to the properties of materials, and the fundamental forces and energies involved in their equilibrium and kinetic behaviour. We will look at the large-scale consequences of these structures in terms of Newtonian and non-Newtonian fluids and see how rheology in turn influences mixing, dispersing, stability and shelf-life. Through case studies and our own investigations, we will look in detail at the theoretical, experimental and analytical advances across a range of different applications of complex fluids.

Course Aims

-Link microscopic structures with macroscopic properties of everyday complex fluid products like foods and cosmetics

-Provide a toolset of observation, interpretation, and analysis to allow students to approach complex fluids in nature and industry with curiosity and awareness of the relevant controlling phenomena

-Enable students and practitioners to have accurate expectations of complex fluid behaviour so that predictions can be made when new situations are encountered.

Course Learning Outcomes

After successfully completing this course, you should be able to:

Learning Outcome	EA Stage 1 Competencies
1. Describe the phenomenological changes wrought on the raw materials of a commercial product during processing to produce a specific property like, for example, viscosity, stability, or colour.	PE1.1, PE1.3, PE1.4
2. Explain the physicochemical basis for the performance of a product during use, such as the melting of solid materials in ice cream to provide a cooling effect in the mouth.	PE1.3, PE1.5, PE2.1
3. Develop the basis for a material with specified properties, like a yield stress below a certain level that recovers within a specified period of time, using key ingredients like polymers, particles, and emulsifiers.	PE1.3, PE2.1, PE2.3, PE3.3, PE3.4

Professional Recognition of Course

This course is part of UNSW Food Science specialisations approved (2021-2026) by the Institute of Food Technologists Higher Education Review Board (IFT HERB).

Teaching Strategies

Please refer to the information in Moodle

Assessment

Assessment task	Weight	Due Date	Course Learning Outcomes Assessed
1. Quiz 1	15%	Friday Week 4	1, 2, 3
2. Quiz 2	15%	Friday Week 7	1, 2, 3
3. Quiz 3	15%	Friday Week 10	1, 2, 3
4. Project	55%	Friday Week 11	1, 2, 3

Assessment 1: Quiz 1

Due date: Friday Week 4

Moodle quiz on course concepts. The quiz mainly requires answering conceptual questions about the course material as well as solving numerical and analytical problems similar to the example questions that will be provided by the lecturer.

Assessment 2: Quiz 2

Due date: Friday Week 7

Moodle quiz on course concepts. The quiz mainly requires answering conceptual questions about the course material as well as solving numerical and analytical problems similar to the example questions that will be provided by the lecturer.

Assessment 3: Quiz 3

Due date: Friday Week 10

Moodle quiz on course concepts. The quiz mainly requires answering conceptual questions about the course material as well as solving numerical and analytical problems similar to the example questions that will be provided by the lecturer.

Assessment 4: Project

Start date: Friday Week 5
Due date: Friday Week 11

This assignment will consist of three equally-weighted tasks. There will also be team evaluations where the performance of each member in the group will be assessed individually by peers.

The group project requires groups to choose a commercial structured fluid product and research its properties through literature, patent, and experimental efforts. Three presentations are made by video on

the product 1) Structure and use 2) Flow and rheology, and 3) Performance to consumer and professional specifications determined by the students from their research.

Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings.

Course Schedule

View class timetable

Timetable

Date	Type	Content
O-Week: 7 February - 11 February		
Week 1: 14 February - 18 February	Lecture	Welcome and introduction to surfaces, colloids, and more (S. Prescott)
Week 2: 21 February - 25 February	Lecture	Introduction to complex fluid flows, phenomena, and applications (P. Spicer)
Week 3: 28 February - 4 March	Lecture	Self-assembly and liquid crystals (S. Prescott)
Week 4: 7 March - 11 March	Lecture	Non-Newtonian flows and rheology (P. Spicer)
Week 5: 14 March - 18 March	Lecture	Polymer solutions and polymers at interfaces (S. Prescott)
Week 6: 21 March - 25 March	Project	Flexibility week: use for consulting time for teams on major project
Week 7: 28 March - 1 April	Lecture	Rheology measurement and modeling (P. Spicer)
Week 8: 4 April - 8 April	Lecture	Emulsions and foams (S. Prescott)
Week 9: 11 April - 15 April	Project	Consulting time for teams on major project
Week 10: 18 April - 22 April	Lecture	Design of fluid microstructure, flow, and performance (P. Spicer)

Resources

Prescribed Resources

Some course materials, and most assessment tasks are delivered through Moodle and students should check regularly for updates and pre-reading assignments.

You can also obtain assistance from the UNSW Library. One starting point for assistance is:

http://www.library.unsw.edu.au/servicesfor/students.html

Recommended Resources

There are many books on the topics relevant to this course but no single textbook covers the whole spectrum. Literature and textbook references will be regularly assigned as pre-reading for lectures. Students will also be required to find information to augment lectures and help with their product development projects.

Some useful references to get you started are:

1. The structure and rheology of complex fluids, Larson, 1999
2. *Surfactants and polymers in aqueous solution*. Holmberg, Jönsson, and Lindman, 2003.
3. *Colloid science: principles, methods and applications*. Cosgrove, Terence, ed.,, 2010.
4. *Bröckel, Ulrich, Willi Meier, and Gerhard Wagner, eds. Product design and engineering: formulation of gels and pastes. 2013.*
5. *Norton and Fryer, Formulation Engineering of Foods, 2013.*
6. *Traitler, H., Coleman, B., & Burbidge, A. Food Industry R&D: A New Approach, 2016.*
7. *Cussler and Moggridge, Chemical Product Design,, 2011.*
8. *Sensory and Consumer Research in Food Product Design and Development, Howard R. Moskowitz and Jacqueline H. Beckley, 2012*

Submission of Assessment Tasks

In the School of Chemical Engineering, all written work will be submitted for assessment via Moodle unless otherwise specified. Attaching cover sheets to uploaded work is generally not required; when you submit work through Moodle for assessment you are agreeing to uphold the Student Code.

Some assessments will require you to complete the work online and it may be difficult for the course coordinator to intervene in the system after the due date. You should ensure that you are familiar with assessment systems well before the due date. If you do this, you will have time to get assistance before the assessment closes.

All submissions are expected to be neat and clearly set out. Your results are the pinnacle of all your hard work and should be treated with due respect. Presenting results clearly gives the marker the best chance of understanding your method; even if the numerical results are incorrect.

Marking guidelines for assignment submissions will be provided at the same time as assignment details to assist with meeting assessable requirements. Submissions will be marked according to the marking guidelines provided.

Late penalties

Unless otherwise specified, submissions received after the due date and time will be penalised at a rate of 5% per day or part thereof (including weekends). For some activities including Moodle quizzes and Team Evaluation surveys, extensions and late submissions are not possible.

Special consideration

If you have experienced an illness or misadventure beyond your control that will interfere with your assessment performance, you are eligible to apply for Special Consideration prior to submitting an assessment or sitting an exam.

UNSW has a Fit to Sit / Submit rule, which means that if you attempt an exam or submit a piece of assessment, you are declaring yourself fit enough to do so and cannot later apply for Special Consideration.

For details of applying for Special Consideration and conditions for the award of supplementary assessment, please see the information on UNSW's Special Consideration page.

Please note that students will need to provide some documentary evidence to support absences from any assessments missed because of COVID-19 public health measures such as isolation. UNSW will **not** be insisting on medical certificates for COVID-related absences of 7 days or less, with the positive PCR or RAT result being sufficient. Longer absences due to self-isolation or COVID-related illness will still need documentation such as a medical certificate.

Applications for special consideration **will still be required** for assessment and participation absences related to COVID-19. Special consideration requests should not be lodged for missing classes if there are no assessment activities in that class.

Academic Honesty and Plagiarism

Academic integrity is fundamental to success at university. Academic integrity can be defined as a commitment to six fundamental values in academic pursuits: honesty, trust, fairness, respect, responsibility and courage (International Center for Academic Integrity, 'The Fundamental Values of Academic Integrity', T. Fishman (ed), Clemson University, 2013). At UNSW, this means that your work must be your own, and others' ideas should be appropriately acknowledged. If you don't follow these rules, plagiarism may be detected in your work.

Further information about academic integrity and plagiarism can be located at:

- The Current Students site
- The ELISE training site

The Conduct and Integrity Unit provides further resources to assist you to understand your conduct obligations as a student: https://student.unsw.edu.au/conduct.

Referencing is a way of acknowledging the sources of information that you use to research your assignments. You need to provide a reference whenever you draw on someone else's words, ideas or research. Not referencing other people's work can constitute plagiarism. Further information about referencing styles can be located at https://student.unsw.edu.au/referencing.

For assessments in the School of Chemical Engineering, we recommend the use of referencing software such as Mendeley or EndNote for managing references and citations. Unless required otherwise specified (i.e. in the assignment instructions) students in the School of Chemical Engineering should use either the APA 7th edition, or the American Chemical Society (ACS) referencing style as canonical author-date and numbered styles respectively.

Academic Information

To help you plan your degree, assistance is available from academic advisors in The Nucleus and also in the School of Chemical Engineering.

Additional support for students

- Current Student Gateway
- Engineering Current Student Resources
- Student Support and Success
- Academic Skills
- Student Wellbeing, Health and Safety
- Equitable Learning Services
- IT Service Centre

Course workload

Course workload is calculated using the Units-Of-Credit (UOC). The normal workload expectation for one UOC is approximately 25 hours per term. This includes class contact hours, private study, other learning activities, preparation and time spent on all assessable work.

Most coursework courses at UNSW are 6 UOC and involve an estimated 150 hours to complete, for both regular and intensive terms. Each course includes a prescribed number of hours per week (h/w) of scheduled face-to-face and/or online contact. Any additional time beyond the prescribed contact hours should be spent in making sure that you understand the lecture material, completing the set assignments, further reading, and revising for any examinations.

On-campus class attendance

Physical distancing recommendations must be followed for all face-to-face classes. To ensure this, only students enrolled in those classes will be allowed in the room. Class rosters will be attached to corresponding rooms and circulated among lab demonstrators and tutors. No over-enrolment is allowed in face-to-face class. Students enrolled in online classes can swap their enrolment from online to a **limited** number of on-campus classes by Sunday, Week 1.

In certain classroom and laboratory situations where physical distancing cannot be maintained or the staff running the session believe that it will not be maintained, face masks will be designated by the course coordinator as **mandatory PPE** for students and staff. Students are required to bring and use their own face mask. Mask can be purchased from IGA Supermarket (Map B8, Lower Campus), campus pharmacy (Map F14, Middle Campus), the post office (Map F22, Upper Campus) and a vending machine in the foyer of the Biological Sciences Building (Map E26, Upper Campus).

Your health and the health of those in your class is critically important. You must stay at home if you are sick or have been advised to self-isolate by NSW health or government authorities. Current alerts and a list of hotspots can be found here. Do not come to campus if you have any of the following symptoms: fever (37.5 °C or higher), cough, sore throat, shortness of breath (difficulty breathing), runny nose, loss of taste, or loss of smell. If you need to have a COVID-19 test, you must not come to campus and remain in self-isolation until you receive the results of your test.

You will not be penalised for missing a face-to-face activity due to illness or a requirement to self-

isolate. We will work with you to ensure continuity of learning during your isolation and have plans in place for you to catch up on any content or learning activities you may miss. Where this might not be possible, an application for fee remission may be discussed. Further information is available on any course Moodle or Teams site.
For more information, please refer to the FAQs: https://www.covid-19.unsw.edu.au/safe-return-campus-faqs

Image Credit

Dr Peter Wich

CRICOS

CRICOS Provider Code: 00098G

Acknowledgement of Country

We acknowledge the Bedegal people who are the traditional custodians of the lands on which UNSW Kensington campus is located.

Appendix: Engineers Australia (EA) Professional Engineer Competency Standard

Program Intended Learning Outcomes	
Knowledge and skill base	
PE1.1 Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline	✓
PE1.2 Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline	
PE1.3 In-depth understanding of specialist bodies of knowledge within the engineering discipline	✓
PE1.4 Discernment of knowledge development and research directions within the engineering discipline	✓
PE1.5 Knowledge of engineering design practice and contextual factors impacting the engineering discipline	✓
PE1.6 Understanding of the scope, principles, norms, accountabilities and bounds of sustainable engineering practice in the specific discipline	
Engineering application ability	
PE2.1 Application of established engineering methods to complex engineering problem solving	✓
PE2.2 Fluent application of engineering techniques, tools and resources	
PE2.3 Application of systematic engineering synthesis and design processes	✓
PE2.4 Application of systematic approaches to the conduct and management of engineering projects	
Professional and personal attributes	
PE3.1 Ethical conduct and professional accountability	
PE3.2 Effective oral and written communication in professional and lay domains	
PE3.3 Creative, innovative and pro-active demeanour	✓
PE3.4 Professional use and management of information	✓
PE3.5 Orderly management of self, and professional conduct	
PE3.6 Effective team membership and team leadership	