

PTRL4024

Drilling Fluids and Cementing

Term 3, 2021



Course Overview

Staff Contact Details

Convenors

Name	Email	Availability	Location	Phone
Zhixi Chen	zhixic@unsw.edu.au	Office hours	Office 211, Level 2. TETB	+61 2 9385 5182

School Contact Information

School of Minerals and Energy Resources
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[Engineering Student Services](#)

E: mere.teaching@unsw.edu.au

W: www.engineering.unsw.edu.au/minerals-energy-resources

Course Details

Units of Credit 6

Summary of the Course

The course covers both the theory and practical applications of drilling fluids and well cementing technology. The main topics include: the functions, composition and additives of drilling fluids; clay and polymer chemistry and applications in drilling fluids; drilling fluid density determination and calculations; drilling fluid filtration and mud caking process; API drilling fluid properties, equipment and testing procedures; chemical analysis; drilling fluid system design for control formation damage and wellbore stability; drilling fluid hydraulics and cuttings transportation; cement manufacture, composition and standardization; cement additives; cement slurry rheology properties; API cementing testing equipment and procedures; cement slurry design and calculations; mud removal by cement; gas migration; cementing equipment and procedures; post-job considerations and evaluation; drilling fluids and cementing laboratory.

Course Aims

This course will enable students to acquire fundamental knowledge of drilling fluids, drilling hydraulics and cementing technique and to apply the theory to the design, evaluation and optimization of drilling fluid program, drilling hydraulics and cementing operations.

Course Learning Outcomes

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

Learning Outcome	EA Stage 1 Competencies
1. Design and evaluate drilling fluid program and cementing operations under specific well conditions	PE1.1, PE1.3, PE2.1, PE2.3, PE3.1, PE3.6
2. Prepare and test drilling fluids and cementing slurry according to API standards	PE1.1, PE1.3, PE2.4, PE3.2, PE3.6
3. Optimize drilling fluid hydraulics for high rate of penetration and cuttings transportation efficiency	PE1.1, PE1.2, PE1.3, PE2.1

Teaching Strategies

1. Weekly lectures are designed to provide students fundamental understanding through a series of topic on drilling fluids, drilling hydraulics and cementing.
2. The fundamental material covered in the lectures is supported by problem-solving exercises in tutorials and class discussions.
3. Learning during lectures is further supported by group based laboratory practices.
4. Online learning support is also available through Moodle.

Assessment

Assessment task	Weight	Due Date	Course Learning Outcomes Assessed
1. Assignment 1: Clay/polymer chemistry	5%	Week 3	1, 2
2. Assignment 2: Mud weight calculations and API properties	5%	Week 5	1, 2
3. Assignment 3: Drilling hydraulics and cuttings transportation	5%	Week 8	3
4. Assignment 4: Cementing calculations	5%	Week 10	1, 2
5. Laboratory	10%	Weekly	2
6. Tutorial	5%	Weekly	1, 2, 3
7. Mid-term Exam	15%	Week 7	1, 2
8. Final Exam	50%	Exam period	1, 2, 3

Assessment 1: Assignment 1: Clay/polymer chemistry

Start date: Week 1

Submission notes: Online Moodle Submission

Due date: Week 3

Clay and polymer

Assessment 2: Assignment 2: Mud weight calculations and API properties

Start date: Week 3

Submission notes: Online submission

Due date: Week 5

Mud weight calculations and API properties

Assessment 3: Assignment 3: Drilling hydraulics and cuttings transportation

Start date: Week 7

Submission notes: Online submission

Due date: Week 8

Drilling hydraulics

Assessment 4: Assignment 4: Cementing calculations

Start date: Week 9
Submission notes: Online submission
Due date: Week 10

Cementing

Assessment 5: Laboratory

Start date: Weekly
Submission notes: Online submission
Due date: Weekly

Laboratory reports

Additional details

Compulsory attendance at laboratories.

Assessment 6: Tutorial

Start date: Weekly
Submission notes: Online submission
Due date: Weekly

Weekly tutorial exercises and quiz

Assessment 7: Mid-term Exam

Start date: Week 7
Submission notes: Online submission
Due date: Week 7

Midterm exam covers week 1 to week 5 lecture contents

Assessment 8: Final Exam

Start date: Exam period
Assessment length: 2 hrs
Due date: Exam period

Covers all topics. A two hours exam will be hold within the exam period. Guidelines for helping the preparation for the final exam will be released prior to the exam.

Attendance Requirements

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

Course Schedule

[View class timetable](#)

Timetable

Date	Type	Content
Week 1: 13 September - 17 September	Lecture	Course introduction; Introduction to drilling fluids; Clay chemistry
	Tutorial	Clay chemistry
Week 2: 20 September - 24 September	Lecture	Clay chemistry; Polymer chemistry and its application in drilling fluid
	Tutorial	Clay and polymer properties
	Laboratory	Laboratory safety induction; Lab 1 - Mud preparation and test
Week 3: 27 September - 1 October	Lecture	Polymer chemistry and its application in drilling fluid; Mud weight calculations
	Tutorial	Mud weight calculations.
Week 4: 4 October - 8 October	Lecture	Drilling fluid filtration; API mud properties; API testing equipment and procedures; Chemical analysis
	Tutorial	API mud properties
	Laboratory	Lab 2 - API mud properties
Week 5: 11 October - 15 October	Lecture	Drilling fluid chemical analysis
	Tutorial	Drilling fluid chemical analysis; Midterm Review
Week 6: 18 October - 22 October	Reading	Flexibility week
Week 7: 25 October - 29 October	Lecture	Drilling hydraulics and cuttings transportation
	Laboratory	Lab 3 - Drilling Fluid Chemical Analysis A
	Assessment	Midterm Quiz (online): Moodle Quiz
Week 8: 1 November - 5 November	Lecture	Drilling hydraulics and cuttings transportation; Cement manufacture, composition and hydration.
	Tutorial	Drilling hydraulics and cuttings transportation

Week 9: 8 November - 12 November	Lecture	Cement slurry properties and additives; Slurry design; Cement calculation.
	Tutorial	Cementing calculation
	Laboratory	Lab 4 - Drilling Fluid Chemical Analysis B
Week 10: 15 November - 19 November	Lecture	Gas migration, Cementing equipment; Cement placement and post job evaluation.
	Tutorial	Final Review
Study Week: 20 November - 25 November	Assessment	Preparation for final exam

Resources

Prescribed Resources

Support material for this course including, whenever available, copies of lecture notes, lecture slides, recommended readings, etc. can be found on Moodle.

The lecture notes/slides may be viewed and downloaded from the UNSW-Moodle:

<http://moodle.telt.unsw.edu.au/>

Recommended Resources

Followings are the recommended books for this course:

- Ryen Caenn, HCH Darley, George R. Gray: Composition and Properties of Drilling and Completion Fluids, 7th edition, Gulf Professional Publishing, Elsevier, 2016.
- Bourgoyne A.T. Jr., Millheim K.K., Chenevert M.E. and Young F.S. Jr.: Applied Drilling Engineering, SPE Textbook Series, Vol. 2, Richardson, TX, USA, 1991.
- Nelson, E.B. and Guillot D.: Well Cementing (Second Edition), Schlumberger, 2006.

Course Evaluation and Development

At the end of each course, all students will have the opportunity to complete a course evaluation form. These anonymous surveys help us understand your views of the course, your lecturers and the course materials. We are continuously improving our courses based on student feedback, and your perspective is valuable.

Feedback is given via <https://student.unsw.edu.au/myexperience> and you will be notified when this is available for you to complete.

We also encourage all students to share any feedback they have any time during the course – if you have a concern, please contact us immediately.

Submission of Assessment Tasks

The School has developed a guideline to help you when submitting a course assignment.

We encourage you to retain a copy of every assignment submitted for assessment for your own record either in hardcopy or electronic form.

All assessments must have an assessment cover sheet attached.

Course completion

Course completion requires submission of all assessment items. Failure to submit all assessment items may result in the award of an Unsatisfactory Failure (UF) grade for the Course unless special consideration has been submitted and approved. Please note, a competency hurdle of 50% is applied to the final assessment.

Late Submission of an Assignment

Full marks for an assignment are only possible when an assignment is received by the due date.

We understand that at times you may not be able to submit an assignment on time, and the School will accommodate any fair and reasonable extension. We would recommend you review the UNSW Special Consideration guidelines – see section below.

Late submission will not be accepted and will be considered as no submission.

Special Consideration

You can apply for special consideration through [The Nucleus Student Hub](#) when illness or other circumstances interfere with your assessment performance. Sickness, misadventure or other circumstances beyond your control may:

- Prevent you from completing a course requirement
- Keep you from attending an assessable activity
- Stop you submitting assessable work for a course
- Significantly affect your performance in assessable work, be it a formal end-of-semester examination, a class test, a laboratory test, a seminar presentation or any other form of assessment

We ask that you please contact the Course Convenor immediately once you have completed the special consideration application, no later than one week from submission.

More details on special consideration can be found at: www.student.unsw.edu.au/special-consideration

Student Support

The University and the Faculty provide a wide range of support services for students, including:

- Library training and support services - www.library.unsw.edu.au

- UNSW Learning Centre - www.lc.unsw.edu.au
- Counselling support - www.counselling.unsw.edu.au

Equitable Learning Services aims to provide all students with a free and confidential service that provides practical support to ensure that your health condition doesn't adversely affect your studies.
<https://student.unsw.edu.au/els>

Academic Honesty and Plagiarism

Your lecturer and the University will expect your submitted assignments are truly your own work. UNSW has very clear guidelines on what plagiarism is and how to avoid it. Plagiarism is using the words or ideas of others and presenting them as your own. Plagiarism is a type of intellectual theft. It can take many forms, from deliberate cheating to accidentally copying from a source without acknowledgement. The University has adopted an educative approach to plagiarism and has developed a range of resources to support students. All the details on plagiarism, including some useful resources, can be found at www.student.unsw.edu.au/plagiarism.

All Mining Engineering students are required to complete a student declaration for academic integrity which is outlined in the assignment cover sheets. By signing this declaration, you agree that your work is your own original work.

If you need some additional support with your writing skills, please contact the Learning Centre or view some of the resources on their website: www.lc.unsw.edu.au. The Learning Centre is designed to help you improve your academic writing and communication skills. Some students use the Centre services because they are finding their assignments a challenge, others because they want to improve an already successful academic performance.

Academic Information

Course Results

For details on UNSW assessment policy, please visit: www.student.unsw.edu.au/assessment

In some instances your final course result may be withheld and not released on the UNSW planned date. This is indicated by a course grade result of either:

- LE – indicates you have not completed one or more items of assessment; or
- WD – indicates there is an issue with one or more assignment; or
- WC – which indicates you have applied for Special Consideration due to illness or misadventure and the course results have not been finalised.

In either event it would be your responsibility to contact the Course Convener as soon as practicable but no later than five (5) days after release of the course result. If you don't contact the convener on time, you may be required to re-submit an assignment or re-sit the final exam and may result in you failing the course. You would also have a NC (course not completed) mark on your transcript and would need to re-enroll in the course.

Studying a course in the School of Minerals and Energy Resources Engineering at UNSW

Report writing guide

The School has a [Report Writing Guide \(RWG\)](#) available. A copy of this is available on the course Moodle site.

Computing Resources and Internet Access Requirements

UNSW Minerals and Energy Resources Engineering provides blended learning using the on-line Moodle LMS (Learning Management System). Also see - Transitioning to Online Learning: www.covid19studyonline.unsw.edu.au

It is essential that you have access to a PC or notebook computer. Mobile devices such as smart phones and tablets may compliment learning, but access to a PC or notebook computer is also required. Note that some specialist engineering software is not available for Mac computers.

- Mining Engineering Students: OMB G48
- Petroleum Engineering Students: TETB LG34 & LG 35

It is recommended that you have regular internet access to participate in forum discussion and group work. To run Moodle most effectively, you should have:

- broadband connection (256 kbit/sec or faster)
- ability to view streaming video (high or low definition UNSW TV options)

More information about system requirements is available at www.student.unsw.edu.au/moodle-system-requirements

Accessing Course Materials Through Moodle

Course outlines, support materials are uploaded to Moodle, the university standard Learning Management System (**LMS**). In addition, on-line assignment submissions are made using the assignment dropbox facility provided in Moodle. All enrolled students are automatically included in Moodle for each course. To access these documents and other course resources, please visit: www.moodle.telt.unsw.edu.au

How We Contact You

At times, the School or your course convenors may need to contact you about your course or your enrolment. Your course convenors will use the email function within Moodle or we will contact you on your @student.unsw.edu.au email address.

We understand that you may have an existing email account and would prefer for your UNSW emails to be redirected to your preferred account. Please see instructions on how to redirect your UNSW emails: "[How can I forward my emails to another account?](#)"

How You Can Contact Us

We are always ready to assist you with your inquiries. To ensure your question is directed to the correct person, please use the email address below for:

- Enrolment or other admin questions regarding your program: <https://unswinsight.microsoftcrmportals.com/web-forms/>
- Course inquiries should be directed to the Course Convenor

Image Credit

Synergies in Sound 2016

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	✓



School of Minerals and Energy Resources Engineering

Assessment Cover Sheet

Course Convenor: _____
Course Code: _____ Course Title: _____
Assignment: _____
Due Date: _____
Student Name: _____ Student ID: _____

ACADEMIC REQUIREMENTS

Before submitting this assignment, the student is advised to review:

- the assessment requirements contained in the briefing document for the assignment;
- the various matters related to assessment in the relevant Course Outline; and
- the *Plagiarism and Academic Integrity* website at < <http://www.lc.unsw.edu.au/plagiarism/pintro.html> > to ensure they are familiar with the requirements to provide appropriate acknowledgement of source materials.

If after reviewing this material there is any doubt about assessment requirements, then in the first instance the student should consult with the Course Convenor and then if necessary with the Director – Undergraduate Studies.

While students are generally encouraged to work with other students to enhance learning, all assignments submitted for assessment must be their entire own work and duly acknowledge the use of other person's work or material. The student may be required to explain any or all parts of the assignment to the Course Convenor or other authorised persons. *Plagiarism* is using the work of others in whole or part without appropriate acknowledgement within the assignment in the required form. *Collusion* is where another person(s) assists in the preparation of a student's assignment without the consent or knowledge of the Course Convenor.

Plagiarism and *Collusion* are considered as Academic Misconduct and will be dealt with according to University Policy.

STUDENT DECLARATION OF ACADEMIC INTEGRITY

I declare that:

- This assessment item is entirely my own original work, except where I have acknowledged use of source material [such as books, journal articles, other published material, the Internet, and the work of other student/s or any other person/s].
- This assessment item has not been submitted for assessment for academic credit in this, or any other course, at UNSW or elsewhere.

I understand that:

- The assessor of this assessment item may, for the purpose of assessing this item, reproduce this assessment item and provide a copy to another member of the University.
- The assessor may communicate a copy of this assessment item to a plagiarism checking service (which may then retain a copy of the assessment item on its database for the purpose of future plagiarism checking).

Student Signature: _____

Date: _____

Students are advised to retain a copy of this assessment for their records and submission should be made in accordance to the assessment details available on the course Moodle site.