# PTRL3040

Numerical Reservoir Simulation

Term 3, 2022

# Course Overview

## Staff Contact Details

### Convenors

| Name | Email | Availability | Location | Phone |
|---|---|---|---|---|
| Furqan Le-Hussain | furqan.hussain@unsw.edu.au | online (Teams) | TETB 219 | |

### Demonstrators

| Name | Email | Availability | Location | Phone |
|---|---|---|---|---|
| Hang Yin | z5139343@unsw.edu.au | online | TETB | |

## School Contact Information

School of Minerals and Energy Resources
Old Main Building, Level 1, 159 (K15)
UNSW SYDNEY NSW 2052 AUSTRALIA

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

This course aims to introduce the student to the background knowledge in numerical reservoir simulation which is a widely used tool in petroleum industry and research and guide the student to learn how to solve reservoir engineering problems through the professional use of numerical reservoir simulation.

This course also a part of the mathematics requirement of the stream. These courses involve development of flow models (partial differential equation), analytical and numerical solution. The knowledge and skills in these courses include: partial differential equations, boundary conditions, numerical differentiation and integration, matrix operations, solution of matrices using exact and iterative methods, errors associated with numerical solutions.

## Course Aims

1. Introduce the student to the background knowledge in numerical reservoir simulation which is a widely used tool in petroleum industry and research
2. Guide the student to learn how to solve reservoir engineering problems through the professional use of numerical reservoir simulation.

## Course Learning Outcomes

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

| Learning Outcome | EA Stage 1 Competencies |
|---|---|
| 1. gain knowledge and skills needed to solve reservoir engineering problems by means of numerical techniques, | PE1.2, PE1.5 |
| 2. apply integrated knowledge of math and basic sciences including geosciences to the solution of problems related to fluid flow in porous media and reservoir performance predictions | PE1.2, PE2.1, PE2.3 |
| 3. Enable students to use reservoir simulators for forecasting future oil and gas production from hydrocarbon reservoirs. | PE2.3, PE3.1 |

## Teaching Strategies

Students are expected to become actively involved in the learning process. In this course we implement new teaching strategies namely: 1) Peer Instruction, 2) Tutorial-Lecture Flipping and 3) Improved Assessment/Feedback.

### Peer Instruction

Peer Instruction (PI) is a pedagogical approach where students learn by discussing their ideas,

knowledge and experience. In practice, after delivering an important topic/concept, we will give students opportunity to discuss the topic covered. PI provides an opportunity for students to clarify their own understanding in a context that is less confronting than directly answering questions from the instructor. This approach builds the learning community as students realize they are not alone in misunderstanding or partially comprehending key concepts, as well as providing feedback to the Instructor on the class comprehension.

**Tutorial-Lecture flipping**

Students are challenged to solve a tutorial question before the related topic has been discussed in the lecture. The students will work in groups. First they will discuss the problem statement with their peers and identify the problem. Tutors will get feedback from various groups and guide them if their problem identification is incorrect. Afterwards, they will identify possible solution methods and finally solve the problem. Again, tutors will incrementally guide students through the solution of the problem. The conclusions drawn from the tutorial align with the basic topics for the following lecture. This means that in the lecture, the lecturer can concentrate more on the advanced or more complicated part of the topic under discussion.

**Improved Assessment/Feedback techniques**

In addition to the conventional approaches, we suggest following techniques

1. At the end of every teaching week, students will solve an online quiz which will test their knowledge. These quizzes will not be a part of the final assessment but will provide formative feedback to students and guide instructors in their teaching.

2. Peer feedback following tutorials. This will not be part of the final assessment

3. Online quizzes on Moodle under exam conditions. These quizzes will contribute to the final assessment.

## Additional Course Information

Prerequisite: PTRL3001

## Assessment

| Assessment task | Weight | Due Date | Course Learning Outcomes Assessed |
|---|---|---|---|
| 1. Project (part 1) | 20% | Week 4 | 1, 2 |
| 2. Project (part 2) | 20% | Week 9 | 1, 2 |
| 3. Quiz | 60% | Week 7 | 1, 2, 3 |
| 4. Final Exam | 50% | Not Applicable | 1, 2, 3 |

### Assessment 1: Project (part 1)

**Due date:** Week 4

First part of the project will involve writing simulation equations for a given problem. Aim of the project is to predict the performance a reservoir.

### Assessment 2: Project (part 2)

**Due date:** Week 9

Aim of the project is to predict the performance a reservoir.

### Assessment 3: Quiz

**Due date:** Week 7

Quiz in week 7

### Assessment 4: Final Exam

**Start date:** UNSW Timetable

Final exam

## 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: 5 September - 9 September | | |
| Week 1: 12 September - 16 September | | Introduction to a simulation study |
| Week 2: 19 September - 23 September | | Simulator equations /<br><br>Practical reservoir simulation |
| Week 3: 26 September - 30 September | | Simulator equations /<br><br>Practical reservoir simulation |
| Week 4: 3 October - 7 October | | Numerical Solutions/<br><br>Practical reservoir simulation |
| | Assessment | Project (part 1) |
| Week 5: 10 October - 14 October | | Numerical Solutions/<br><br>Practical reservoir simulation |
| Week 6: 17 October - 21 October | | Online discussions/revision (optional) |
| Week 7: 24 October - 28 October | | Model initialization |
| | Assessment | Quiz |
| Week 8: 31 October - 4 November | | Treatment of wells |
| Week 9: 7 November - 11 November | | Pseudo-functions |
| | Assessment | Project (part 2) |
| Week 10: 14 November - 18 November | | CO2 Sequestration |

# Resources

## Prescribed Resources

Not available

## Recommended Resources

Not available

## 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.

## Late Submission of an Assignment

Full marks for an assessment are only possible when an assessment is received by the due date. Work submitted late without an approved extension by the course coordinator or delegated authority is subject to a late penalty of five percent (5%) of the maximum mark possible for that assessment item. The late penalty is applied per calendar day (including weekends and public holidays) that the assessment is overdue. There is no pro-rata of the late penalty for submissions made part way through a day. This is for all assessments where a penalty applies.

Work submitted after five days (120 hours) will not be accepted and a mark of zero will be awarded for that assessment item.

For some assessment items, a late penalty may not be appropriate. These will be indicated in the course outline, and such assessments will receive a mark of zero if not completed by the specified date. Examples include:

- Weekly online tests or laboratory work worth a small proportion of the subject mark, or
- Online quizzes where answers are released to students on completion, or Professional assessment tasks, where the intention is to create an authentic assessment that has an absolute submission date, or Pass/Fail assessment tasks.

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.

## 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 MERE 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

*This course outline sets out description of classes at the date the Course Outline is published. The nature of classes may change during the Term after the Course Outline is published. Moodle should be consulted for the up to date class descriptions. If there is any inconsistency in the description of activities between the University timetable and the Course Outline (as updated in Moodle), the description in the Course Outline/Moodle applies.*

## 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 | |