School of Minerals & Energy Resources Engineering

UNSW Engineering

PTRL5021

Reservoir Characterisation

Term 2, 2023

Course Overview

Staff Contact Details

Convenors

Name	Email	Availability	Location	Phone
Christoph Arns	c.arns@unsw.edu.au		TETB 220	043479723 9

Lecturers

Name	Email	Availability	Location	Phone
Christoph Arns	c.arns@unsw.edu.au		TETB 220	043479723 9

School Contact Information

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

For current students, all enquiries and assistance relating to enrolment, class registration, progression checks and other administrative matters, please see The Nucleus: Student Hub.

Web & Important Links:
School of Minerals and Energy Resources
The Nucleus Student Hub
Moodle
UNSW Handbook
UNSW Timetable
Student Wellbeing
Urgent Mental Health & Support
Equitable Learning Services

Course Details

Units of Credit 6

Summary of the Course

Overview of reservoir characterisation and modelling problems. Reservoir mapping. 3D modelling. Univariate, bivariate and multivariate statistics for geological data analysis. Pattern recognition techniques. Petrophysical predictions from well logs. Introduction to petroleum geostatitsics. Variograms. Kriging. Uncertainty quantification. Stochastic reservoir modelling. Sequential simulation. Gaussian simulation. Indicator simulation. Integrating seismic attributes, well tests and production data. Constraining reservoir models with various sources of information. Reservoir upgridding and upscaling. Special Project (Ref: PTRL3013)

Course Learning Outcomes

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

Learning Outcome	EA Stage 1 Competencies
1. Demonstrate knowledge and skills needed to cross-correlate petrophysical properties.	PE1.2, PE1.3, PE1.1, PE1.4, PE2.1, PE2.2
2. Design and populate continuum 3D grids for the purpose of reservoir simulation using geostatistical interpolation techniques (Kriging) and stochastic simulation.	PE1.2, PE1.3, PE1.5, PE2.1, PE2.2, PE2.4
3. Upscale simulation grids for real and categorical variables.	PE1.2, PE1.3, PE2.1, PE3.1, PE3.2, PE3.3, PE3.4, PE3.5, PE3.6

Teaching Strategies

We seek to create an interesting, challenging, relevant, and engaging education experience. The teaching approach to be employed will involve lectures and tutorials. We are using the combination of lectures, tutorials and student presentations in a different manner to the standard approach. Through a problem-based approach this course aims to provide students the basic knowledge of geological factors impacting on field development. Problem-based learning (PBL) teaches students to explore real-world problems and challenges. In problem-based learning, students are presented with an example of a real-life situation and asked to analyse it and/or propose solutions. Students will gain practical experience and knowledge through inquiry based learning in class exercises, self-study and hands-on work within team-based projects.

The lectures set out the main conceptual frameworks for each topic. They synthesise materials from various sources. You are advised to attend the lectures or start with the online lectures to get the main ideas then read the textbook and other relevant materials.

The tutorials will consist of one or more in-class exercise designed to reinforce the content covered in the previous lecture.

Assessment

Assessment task	Weight	Due Date	Course Learning Outcomes Assessed
1. Individual assignment	15%	02/07/2023 05:00 PM	1, 2, 3
2. Quiz 1 – 7	15%	Not Applicable	1, 2, 3
3. Major Group Assignment	30%	05/08/2023 05:00 PM	1, 2, 3
4. Final Exam	40%	Not Applicable	1, 2, 3

Assessment 1: Individual assignment

Start date: 31/05/2023 09:00 AM
Due date: 02/07/2023 05:00 PM

This assignment targets individual skills and prepares for the the group component of the course. It should be completed at an individual level with a separate submission by each student in the first four weeks of the course. Each student will have a somewhat different task and/or datasets. Common to all is the application of univariate statistics, basic programming in MATLAB including generation of random numbers, and the correlation of data either for multiple physical properties at the same location, or the same physical property at different locations, as well as spatial interpolation.

This is not a Turnitin assignment

Assessment 2: Quiz 1 – 7

The quizzes are online and designed to enforce the revision of weekly material. There is one quiz each week for weeks 1-7; each quiz is due at the end of the respective week and can be repeated as many times as desired. A minimum pass mark of 75 is required.

Assessment 3: Major Group Assignment

Start date: 28/06/2023 01:00 PM
Assessment length: 6000 words
Due date: 05/08/2023 05:00 PM

Students will perform team work in groups of ~6 students. For the team projects, groups will be formed by the lecturer randomly. Each group will then be assigned a project topic. The teams will meet once a week to discuss the topic as soon as the projects starts. At the first meeting, they will elect a team leader and secretary. Minutes of all meetings must be written and will be assessed. The assessment will be made based on teamwork skills, a technical report of 6000 words (max) and an oral presentation of 20 minutes. Weighting of the marks is 60% technical report, 40% presentation, and up to 20% bonus for individual effort. Individual effort can be a negative entry and is based on presentation and peer assessment. In the unlikely case of no contribution the peer assessment can result in a zero mark for the assignment.

This assignment is submitted through Turnitin and students can see Turnitin similarity reports.

Assessment 4: Final Exam

Submission notes: to be scheduled online during the exam period

The final exam tests the learning outcomes of the course in an exam setting.

This is not a Turnitin assignment

Attendance Requirements

Please note that lecture recordings are not available for this course. Students are strongly encouraged to attend all classes and contact the Course Authority to make alternative arrangements for classes missed.

Course Schedule

[View class timetable](#)

Timetable

Date	Type	Content
O-Week: 22 May - 26 May		
Week 1: 29 May - 2 June	Blended	Introduction to reservoir characterisation and input data, grids, and properties
	Tutorial	MATLAB recap
Week 2: 5 June - 9 June	Blended	Data quality control
	Tutorial	Basic distributions and their analysis, data quality control
Week 3: 12 June - 16 June	Blended	Petrophysical cross-correlations
	Tutorial	Functions, weights, surface plots
Week 4: 19 June - 23 June	Blended	Spatial modelling I
	Tutorial	Interpolation, experimental variograms, trends & residual variables
Week 5: 26 June - 30 June	Blended	Spatial modelling II
	Tutorial	Simple & ordinary Kriging
Week 6: 3 July - 7 July	Homework	Flexibility week
Week 7: 10 July - 14 July	Blended	Stochastic modelling I
	Tutorial	Group projects
Week 8: 17 July - 21 July	Blended	Stochastic modelling II
	Tutorial	Group projects
Week 9: 24 July - 28 July	Blended	Upscaling
	Tutorial	Group projects
Week 10: 31 July - 4	Presentation	Group presentations for the reservoir

August		characterisation case study

Resources

Prescribed Resources

UNSW Minerals and Energy Resources Engineering provides blended learning using the on-line Moodle LMS (Learning Management System). 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. 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.

Recommended Resources

Recommended Books:

1. J.L. Jensen, L.W. Lake, P.W.M. Corbett, D.J. Goggin, *Statistics for Petroleum Engineers and Geoscientists*, 2nd ed., Elsevier 2007.
2. Lake, L. W. and Carroll, H. B. *Reservoir Characterization*: Academic Press 1986.
3. Jef Caers, *Petroleum Geostatistics*, SPE.
4. E.H. Isaaks and R.M. Srivastava, *Applied Geostatistics:* Oxford University Press 1989.

Discipline-specific WWW Resources:

www.appea.com.au	(The Australian Petroleum Production and Exploration Association)
www.pesa.com.au	(The Petroleum Exploration Society of Australia)
www.spwla.org	(Society of Petrophysicists & Well Log Analysts)
www.spe.org	(Society of Petroleum Engineers)
www.api.org	(American Petroleum Institute – For Petroleum Standards)

Course Evaluation and Development

Student feedback is considered immediately where possible, e.g. through online interaction with the course being setup on teams including channels for each group. This allows tutors and lecturers to monitor progress and provide feedback. E.g., last year we quickly moved from zoom to teams due to its higher flexibility. We will this year again use teams and moodle.

As summary method we further utilize the 'myExperience' results. The last year was the first time the course was run in full online mode. Student comments included issues that connection was sometimes poor, leading to difficulties in facing each other in group discussions as well as preventing the lecturer from forcing students online with camera on, thus somewhat enforcing attendance. Furthermore, group projects were combining students from different time zones - this in our eyes is a design feature, as it develops the capability of students to work with students of different cultural background. On the positive

side students liked the online programming with tutors monitoring and being able to answer questions at any time as well as the availability of lecture recordings for revision, as well as the group assignment. Also, the online quizzes were highly appreciated as review technique and will be further expanded this year.

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 may be eligible for special consideration, when an illness or other short-term events beyond your control (exceptional circumstances) affect your assessment performance. More details on special consideration can be found at: www.student.unsw.edu.au/special-consideration

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.

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
- Academic Skills Support - https://www.student.unsw.edu.au/skills
- Psychology and Wellness - 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 academic skills, please contact the Academic Skills Support or view some of the resources on their website: https://www.student.unsw.edu.au/skills. The Academic Skills Team can provide resources, support and assistance to help you improve your academic 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

Student Resources

This engineering student resources section collates useful advice and information to ensure you're able to focus on your studies.

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:

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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	✔