UNSW Course Outline

PTRL5021 Reservoir Characterisation - 2024

Published on the 27 May 2024

General Course Information

Course Code : PTRL5021
Year : 2024
Term : Term 2
Teaching Period : T2
Is a multi-term course? : No
Faculty : Faculty of Engineering
Academic Unit : School of Minerals & Energy Resources Engineering
Delivery Mode : In Person
Delivery Format : Standard
Delivery Location : Kensington
Campus : Sydney
Study Level : Postgraduate
Units of Credit : 6

Useful Links

Handbook Class Timetable

Course Details & Outcomes

Course Description

This course enables students with the skills to develop static reservoir models capturing heterogeneity at multiple scales and across different physical properties, central for accurate fluid flow simulations in reservoir engineering. Central to this is the integration of diverse data

sources, like seismic surveys, well logging, and core analysis. The course places a strong emphasis on the application of geostatistical methods including data quality control, multivariate analysis, Kriging, and stochastic simulation. These techniques are applied to the spatial assignment of reservoir properties, the handling of dependent variables, and change of scales.

Course Aims

Reservoir characterisation uses geological data to describe, quantify, and model the heterogeneous elements in a reservoir and provides a spatial continuous assignment of physical properties relevant for reservoir modelling including their uncertainty. The determination of reservoir uncertainty is a crucial aspect of reservoir modelling in addition to the estimation of basic quantities like fluid volumes, fluid flow, and reservoir performance and/or recovery factors.

This course integrates the various data sources required to generate a static reservoir model suitable for reservoir engineering purposes. It builds on knowledge from geology and geophysics as well as formation evaluation and prepares the ground for reservoir modelling. A key concept is the correlation between different physical properties at different scales, their spatial distribution, and combining those measurements to generate a 3D reservoir model continuous in space, suitable for fluid transport calculations.

Specifically, reservoir characterisation aims to:

1. Introduce the student to the background knowledge in reservoir characterisation and modellingmodelling.
2. Guide the student in integrating extra-ordinarily sparse data spatially, across properties, and scales by application of geostatistical techniques.

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Demonstrate knowledge and skills needed to cross-correlate petrophysical properties.
CLO2 : Design and populate continuum 3D grids for the purpose of reservoir simulation using geostatistical interpolation techniques (Kriging) and stochastic simulation.
CLO3 : Upscale simulation grids for real and categorical variables.

Course Learning Outcomes	Assessment Item
CLO1 : Demonstrate knowledge and skills needed to cross-correlate petrophysical properties.	• Individual assignment • Quiz 1 – 7 • Assessment 2 • EXAM
CLO2 : Design and populate continuum 3D grids for the purpose of reservoir simulation using geostatistical interpolation techniques (Kriging) and stochastic simulation.	• Individual assignment • Quiz 1 – 7 • Assessment 2 • EXAM
CLO3 : Upscale simulation grids for real and categorical variables.	• Individual assignment • Quiz 1 – 7 • Assessment 2 • EXAM

Learning and Teaching Technologies

Moodle - Learning Management System | Microsoft Teams

Learning and Teaching in this course

Moodle will be used for class schedules, distributing advanced reading etc. This is accompanied by MS Teams. The latter will be utilized to organise teams (separate channels for each group).

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Individual assignment Assessment Format: Individual	15%	Start Date: Not Applicable Due Date: Not Applicable
Quiz 1 – 7 Assessment Format: Individual	15%	Start Date: Not Applicable Due Date: Week 1: 27 May - 02 June, Week 2: 03 June - 09 June, Week 3: 10 June - 16 June, Week 4: 17 June - 23 June, Week 5: 24 June - 30 June, Week 7: 08 July - 14 July
Assessment 2 Assessment Format: Group	30%	Start Date: Not Applicable Due Date: Week 10: 29 July - 04 August
EXAM Assessment Format: Individual	40%	Start Date: Exam period Due Date: Exam period

Assessment Details

Individual assignment

Assessment Overview

This assignment tests basic skills developed during the first part of the course. Students are presented with randomized scenarios for most of the questions. The assignment is submitted online through moodle.

Course Learning Outcomes

- CLO1 : Demonstrate knowledge and skills needed to cross-correlate petrophysical properties.
- CLO2 : Design and populate continuum 3D grids for the purpose of reservoir simulation using geostatistical interpolation techniques (Kriging) and stochastic simulation.
- CLO3 : Upscale simulation grids for real and categorical variables.

Assignment submission Turnitin type

This is not a Turnitin assignment

Quiz 1 – 7

Assessment Overview

Individual multiple choice weekly online quizzes to reflect on lecture material over the first 7 weeks of the course. Each quiz has to be completed within a week of the corresponding lectures and tutorials. Unlimited repetitions are allowed and the minimum pass mark for each quiz is 75. Feedback is immediate (automatic).

Course Learning Outcomes

- CLO1 : Demonstrate knowledge and skills needed to cross-correlate petrophysical properties.
- CLO2 : Design and populate continuum 3D grids for the purpose of reservoir simulation using geostatistical interpolation techniques (Kriging) and stochastic simulation.
- CLO3 : Upscale simulation grids for real and categorical variables.

Assignment submission Turnitin type

Not Applicable

Assessment 2

Assessment Overview

Students will perform team work in groups of 5-6 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 start. At the first meeting, they will elect a team leader and a secretary. Minutes of all meetings must be written and will be assessed. Each team will also meet the lecturer once a week for 15 minutes. The assessment will be made based on teamwork skills, a technical report (max 6000 words) and an oral presentation of 20 minutes.

Course Learning Outcomes

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- CLO2 : Design and populate continuum 3D grids for the purpose of reservoir simulation using geostatistical interpolation techniques (Kriging) and stochastic simulation.
- CLO3 : Upscale simulation grids for real and categorical variables.

Assessment Length

6000 words

Assignment submission Turnitin type

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

EXAM

Assessment Overview

The final 2h exam is a summative assessment testing the knowledge acquired over the course. It is hold during the exam period. The exam is structured into a series of categories and questions pertaining to each of these are randomized. The exam consists of a combination of multiple choice questions, tasks where calculations need to be performed, and essay questions.

Course Learning Outcomes

- CLO1 : Demonstrate knowledge and skills needed to cross-correlate petrophysical properties.
- CLO2 : Design and populate continuum 3D grids for the purpose of reservoir simulation using geostatistical interpolation techniques (Kriging) and stochastic simulation.
- CLO3 : Upscale simulation grids for real and categorical variables.

Submission notes

to be scheduled online during the exam period

Assignment submission Turnitin type

This is not a Turnitin assignment

Hurdle rules

Students need to achieve a pass mark.

General Assessment Information

Grading Basis

Standard

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 27 May - 2 June	Lecture	Input data/grids/properties
	Tutorial	Matlab basics, random numbers
Week 2 : 3 June - 9 June	Lecture	Data quality control
	Tutorial	Matlab, basic stats and data quality control
Week 3 : 10 June - 16 June	Lecture	Petrophysical cross-correlations
	Tutorial	Matlab, cross-correlations between variables
Week 4 : 17 June - 23 June	Lecture	Spatial modelling I
	Tutorial	Matlab, spatial interpolation
Week 5 : 24 June - 30 June	Lecture	Spatial modelling II
	Tutorial	Matlab, spatial modelling
Week 7 : 8 July - 14 July	Lecture	Stochastic simulation I
	Group Work	Groupwork, stochastic simulation
Week 8 : 15 July - 21 July	Lecture	Stochastic simulation II
	Group Work	Groupwork, stochastic simulation
Week 9 : 22 July - 28 July	Lecture	Upscaling
	Group Work	Upscaling
Week 10 : 29 July - 4 August	Activity	Revision and groupwork

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

Discipline-specific WWW Resources:

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.

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	Christoph Arns		TETB 220	434797239		No	Yes
Lecturer	Ying Da Wang					No	No

Other Useful Information

Academic Information

I. Special consideration and supplementary assessment

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, or within 3 working days of, submitting an assessment or sitting an exam.

Please note that UNSW has a Fit to Sit rule, which means that if you sit an exam, 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.

II. Administrative matters and links

All students are expected to read and be familiar with UNSW guidelines and polices. In particular, students should be familiar with the following:

- Attendance
- UNSW Email Address
- Special Consideration
- Exams
- Approved Calculators
- Academic Honesty and Plagiarism
- Equitable Learning Services

III. Equity and diversity

Those students who have a disability that requires some adjustment in their teaching or learning environment are encouraged to discuss their study needs with the course convener prior to, or at the commencement of, their course, or with the Equity Officer (Disability) in the Equitable Learning Services. Issues to be discussed may include access to materials, signers or note-takers, the provision of services and additional exam and assessment arrangements. Early notification is essential to enable any necessary adjustments to be made.

IV. Professional Outcomes and Program Design

Students are able to review the relevant professional outcomes and program designs for their streams by going to the following link: https://www.unsw.edu.au/engineering/student-life/student-resources/program-design.

Note: This course outline sets out the 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 or your primary learning management system (LMS) 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/Moodle/LMS, the description in the Course Outline/Moodle/LMS applies.

Academic Honesty and Plagarism

UNSW has an ongoing commitment to fostering a culture of learning informed by academic integrity. All UNSW students have a responsibility to adhere to this principle of academic integrity. Plagiarism undermines academic integrity and is not tolerated at UNSW. *Plagiarism at UNSW is defined as using the words or ideas of others and passing them off 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. UNSW has produced a website with a wealth of resources to support students to understand and avoid plagiarism, visit: student.unsw.edu.au/plagiarism. The Learning Centre assists students with understanding academic integrity and how not to plagiarise. They also hold workshops and can help students one-on-one.

You are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students should allow sufficient

time for research, drafting and the proper referencing of sources in preparing all assessment tasks.

Repeated plagiarism (even in first year), plagiarism after first year, or serious instances, may also be investigated under the Student Misconduct Procedures. The penalties under the procedures can include a reduction in marks, failing a course or for the most serious matters (like plagiarism in an honours thesis or contract cheating) even suspension from the university. The Student Misconduct Procedures are available here:

www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf

Submission of Assessment Tasks

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, per calendar day.

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 clearly 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;
- Exams, peer feedback and team evaluation surveys;
- Online quizzes where answers are released to students on completion;
- Professional assessment tasks, where the intention is to create an authentic assessment that has an absolute submission date; and,
- Pass/Fail assessment tasks.

Faculty-specific Information

Engineering Student Support Services – The Nucleus - enrolment, progression checks, clash requests, course issues or program-related queries

Engineering Industrial Training – Industrial training questions

UNSW Study Abroad – study abroad student enquiries (for inbound students)

UNSW Exchange – student exchange enquiries (for inbound students)

UNSW Future Students – potential student enquiries e.g. admissions, fees, programs, credit transfer

Phone

(+61 2) 9385 8500 – Nucleus Student Hub

(+61 2) 9385 7661 – Engineering Industrial Training

(+61 2) 9385 3179 – UNSW Study Abroad and UNSW Exchange (for inbound students)

School-specific Information

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.

Submission of Assessment Tasks

We encourage you to retain a copy of every assignment submitted for your own record, either in hardcopy or electronic form. All assessments must have an assessment cover sheet attached (if required).

Student Resources

The School has student resources section, containing 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 online Moodle LMS (Learning Management System). Also see - Transitioning to Online

Learning: www.covid19studyonline.unsw.edu.au

Note that some specialist engineering software is not available for Mac computers.

- Mining Engineering Students: OMB G48
- Petroleum Engineering Students: TETB LG34 & LG35

For 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

School Contact Information

School of Minerals and Energy Resources Engineering
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