Faculty of Engineering

**School of Minerals and Energy Resources Engineering**

Undergraduate Course Outline

PTRL2020

Petrophysics

Dr Hamid Roshan

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## 1. INFORMATION ABOUT THE COURSE

| Course Code: | PTRL2020 | Term: | T2 | Level: | UG | Units/Credits | 6 UOC |
|---|---|---|---|---|---|---|---|
| Course Name: | **Petrophysics** | | | | | | |

| Course Convenor: | **Dr Hamid Roshan** | | |
|---|---|---|---|
| Contact Details | School of Minerals and Energy Resources Engineering<br>TETB 221 | EMAIL: | h.roshan@unsw.edu.au |
| | | Phone: | +61 2 9385 5535 |
| Contact times | **Lecture and tutorial time schedule**<br>Lectures are on Mondays from 15:00 to 18:00<br>Tutorials are on Tuesdays from 13:00 to 15:00<br>Laboratory sessions are on Wednesdays from 10:00 to 12:00 (week 2, 4, 8 and 10)<br>All components of the course will be delivered online on Blackboard and Moodle.<br>Lectures and tutorials recordings will be available on Moodle and all communications will be taken place in Moodle forum. | | |
| Course demonstrator | **TBC** | | |

### 1.1. Course Description

Physics and Principle of Well-logging
Well-logging Tools
Well-log interpretation (lithology)
Well-log interpretation (Petrophysical Properties)
Petrophysical Laboratory measurements

### 1.2. Course Completion

Course completion requires submission of all assessment items; failure to submit all assessment items can result in the award of an Unsatisfactory Failure (UF) grade for the Course. Please note that a competency hurdle of 50% is applied to the final exam/assessment.

### 1.3. Assumed Knowledge

Prerequisite: N/A

### 1.4. Attendance

To pass this course it is expected that you will attend at least 80% of tutorials and lectures. *If your attendance is below 80% your final report might not be considered*. Attendance will be recorded when applicable. Normally, there is no make-up work for poor attendance. If you have misadventure or ill-health, please contact your course coordinator as soon as possible. The attendance requirement is not meant to be punitive. It is included because participation is an important part of achieving the course outcomes.

## 2. AIMS, LEARNING OUTCOMES AND GRADUATE ATTRIBUTES

### 2.1. Course Aims

In this course, students are introduced to reservoir rock and fluid properties and learn the fundamental of well logging and log interpretation. The integration of fluid-rock properties through core analysis along with well-log interpretation forms the foundation of reservoir evaluation. As part of the course, students are also introduced to real well-log data for quality control, analysis and interpretation.

### 2.2. Learning Outcomes

a) Understanding the petrophysical properties of the reservoirs and the ways they are measured in routine and special core analysis workflow
b) Hands-on experience with laboratory measurements of fluid-rock reservoir properties
c) Obtaining knowledge of physical principles of well logging and the tools used to measure petrophysical properties
d) Fundamentals of quantitative and qualitative interpretation of well-log data
e) Simple interpretation of a set of real well-log data using gained knowledge.

## 3. REFERENCE RESOURCES

### 3.1. Reference Materials

Wyllie, M R, Fundamentals of Well Log Interpretation, 1963.
Serra, O, Fundamentals of Well Log Interpretation, Elsevier, 1978.
Ellis, D, Well Logging for Earth Scientists, 1987.

### 3.2. Text (if applicable)

Interactive lecture note is available on Moodle. Digital examples are also available throughout the course through Moodle.

## 3.3. Other Resources (if applicable)

Bateman, R, Log Quality Control, 1984.
Bateman, R M, Open Hole Log Analysis and Formation Evaluation, International Human Resources Development Corporation, Boston, 1985.
British Petroleum Co. Ltd, Our Industry Petroleum, Jarrold & Sons, Norwich, 1977.
Clark, N, Elements of Petroleum Reservoirs, SPE Series, 1960.
CoreLab, Fundamentals of Core Analysis, 1973.
Desbrandes, R, Encyclopedia of Well Logging, 1985.
Dewan, J, Essentials of Modern Open Hole Logging, 1983.
Dresser Atlas, Well Logging and Interpretation Techniques, 1982.
Dresser Atlas, Log Interpretation Charts, 1985.
Helander, D, Fundamentals of Formation Evaluation, 1983.
Hilchie, D, Applied Open Hole Log Operations, 1982.
Lynch, E, Formation Evaluation, 1962.
Pirson, S, Geologic Well Log Analysis. Schlumberger, Log Interpretation Principles/Applications, 1989
Schlumberger, Log Interpretation Charts, 1995.
Stokes, W L, Essentials of Earth History, Prentice-Hall Inc., Englewood Cliffs, NJ, 1960.

## 3.4. Online Resources

| | |
|---|---|
| Society of Petroleum Engineers: | http://www.spe.org |
| Australian Petroleum Production and Exploration Association: | http://www.appea.com.au |
| American Association of Petroleum Geologists: | http://www.geobyte.com |
| Petroleum Exploration Society of Australia: | http://www.pesa.com.au |
| American Petroleum Institute – For Petroleum Standards | www.api.org |
| Society of Petrophysicists & Well Log Analysts | www.spwla.org |
| European Association of Geoscientists & Engineers | www.eage.org |
| The Society of Exploration Geophysicists | www.seg.org |

## 3.5. Report Writing Guide

The School has a report writing guide (RWG) available. A copy of this is available on the course Moodle site.

# 4. COURSE CONTENT AND LEARNING ACTIVITIES

## 4.1. Course content

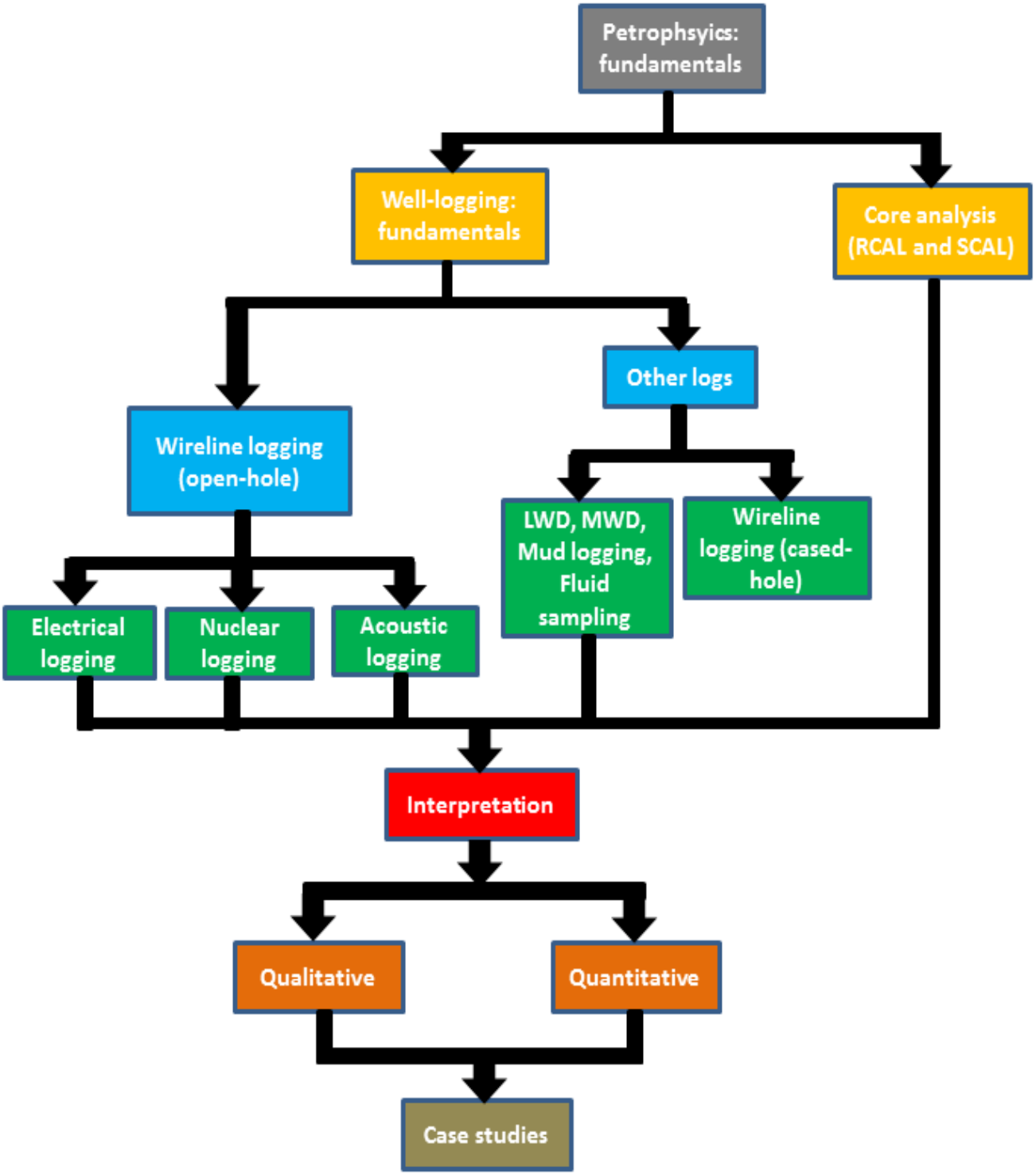
- Acquisition of Petrophysical Data
- Routine and special core analysis
- Open-hole logging
- Log interpretation (lithology)
- Log interpretation (quantitative)

## 4.2. Learning Activities Summary

| Week | Lecture | Tutorial | Laboratory |
|---|---|---|---|
| 1 | • Introduction to petrophysics and well logging | • Analysis of the scaling factor<br>• Caliper log analysis<br>• Mud logging example | • None |
| 2 | • Resistivity logging | • Deep resistivity<br>• Temperature and NaCl equivalent | • Measurement of gas permeability |
| 3 | • SP and radioactive logging | • SP example<br>• SGR<br>• Hydrogen index and Neutron porosity | • None |
| 4 | • Continue radioactive and Sonic logging | • Porosity<br>• Young modulus and Poisson ratio | • Measurement of electrical resistivity |
| 5 | • Lithology interpretation | • Lithology interpretation examples | • None |
| 7 | • Lithology identification | • Mid-term exam | • None |
| 8 | • Shale volume calculation<br>• Porosity estimation | • Calculation of shale volume<br>• Lithology identification with crossplots | • Measurement formation fluid properties |
| 9 | • Water saturation | • Hingle and Pickett crossplots | • None |
| 10 | • Continue water saturation<br>• Movable hydrocarbon and cut-offs<br>• Introduction to Artificial Intelligence in Formation Evaluation (a permeability example) | • Saturation in shaly formations | Measurement of capillary pressure |

Other UNSW Key dates: https://student.unsw.edu.au/new-calendar-dates

# Course Flowchart



## 5. COURSE ASSESSMENT

### 5.1. Assessment Summary

The course will have an assignment, laboratory reports, mid-term and final exam.

| Assessment Task | Due date | Weight (%) |
|---|---|---|
| Assignment 1 | End of week 5 | 10 |
| Laboratory reports | Will be provided by Dr Chen | 25 |
| Mid-term exam | Week 7 in tutorial hrs | 25 |
| Final exam | As per University schedule | 40 |

Assignments related details/submission-box will be available online through Moodle. Access to the Moodle site is via the Moodle icon on the MyUNSW homepage.

## 6. ASSESSMENT CRITERIA

The assessment criteria provide a framework for you to assess your own work before formally submitting major assignments to your course convenor. Your course convenor will be using this framework to assess your work and as a way to assess whether you have met the listed learning outcomes and the graduate attributes for your program. We ask that you don't use the assessment criteria guidelines as a checklist, but as a tool to assess the quality of your work. Your course convenor will also be looking at the quality, creativity and the presentation of your written assignment as they review the framework. Rubrics, wherever applicable, will be provided at the time of the assignment release.

## 7. STUDYING AN UG COURSE IN UNSW MINERALS AND ENERGY RESOURCES ENGINEERING

### 7.1. 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 these instructions on how to redirect your UNSW emails: https://www.it.unsw.edu.au/students/email/index.html

### 7.2. 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: these should be directed to the Course Convenor.

### 7.3. Computing Resources and Internet Access Requirements

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

Mining Engineering Students: OMB G48/49
Petroleum Engineering Students: TETB

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

### 7.4. 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

### 7.5. Assignment Submissions

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.

### 7.6. Late Submission of an Assignment

Each project task should be completed within a specified time period and by the due date. There will be no extension for the submissions and the late submission will attract a penalty up to 10% of the assessment task value per day. The submission due dates and instructions are given in appropriate section of this document.

### 7.7. Special Consideration

You can apply for special consideration through UNSW Student Central 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

### 7.8. 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:

- WD – which usually indicates you have not completed one or more items of assessment or 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.

### 7.9. Students Needing Additional Support

The Student Equity and Disabilities Unit (SEADU) aims to provide all students with support and professional advice when circumstances may prevent students from achieving a successful university education. Take a look at their webpage: www.studentequity.unsw.edu.au/

### 7.10. 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.

## 7.11. Continual Course Improvement

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.

## 8. SCHOOL ASSESSMENT COVER SHEET

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.**