PTRL4020

Natural Gas Engineering

Term 1, 2023

Course Overview

Staff Contact Details

Convenors

Name	Email	Availability	Location	Phone
Furqan Hussain	furqan.hussain@unsw.edu.au		Tyree building	

Lecturers

Name	Email	Availability	Location	Phone
Habib Zughbi	h.zughbi@unsw.edu.au	M-F 5-6 pm	TBA	0431746278

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
Faculty Transitional Arrangements for COVID-19

Course Details

Units of Credit 6

Summary of the Course

Properties of hydrogen. Properties of natural gases: typical compositions. Definition of terms. Basic concepts of thermodynamics: the energy equation; ideal gas heat capacities, mean heat capacities; enthalpy; heating values of fuels; greenhouse gas contributions. Consequences of the second law of thermodynamics: power plant limitations; LNG power requirements. Equations of state: general cubic equations, specific high accuracy equations. Use of equations of state to find residual energy properties. Gas compression: positive displacement and centrifugal compressors; fans. Calculation of poser requirements; isothermal, isentropic, polytropic efficiencies. Compressible flow: fundamental equations of flow: continuity, momentum, energy equations. Choking in nozzles and valves. Low velocity isothermal flow in horizontal and vertical pipes: the Weymouth equation; high velocity limitations. Introduction to gas hydrates; predicting hydrate formation; estimating rates of injection for hydrate inhibitors. Naturally occurring hydrates as an energy resource. Unconventional resources for natural gas (coalbed methane, shale gas, tight gas). Production technolgies of hydrogen

Course Aims

Natural gas and hydrogen are becoming an increasingly important part of Australia's and the world's energy supply. Further, natural gas is put forward as a low emission alternative to other fossil fuels, while hydrogen is seen as the ultimate source of fuel to reduce GHG emissions. An extreme surge in research aiming at producing hydrogen at a competitive cost and the development of technologies to allow the development of unconventional gas resources has further added to the likelihood of having H2 commercially as a fuel and also to the expansion in the supply and demand for natural gas. It is important that Petroleum Engineering graduates understand the technical, economic and social issues at play in the development of hydrogen generation and natural gas resources.

The technical aspects of natural gas developments are covered throughout the Petroleum Engineering Program as part of other reservoir engineering, geology, drilling and production courses. This course complements these other courses by aiming to:

1. Combine students existing knowledge of fluid flow with a thorough grounding in the analysis and prediction of the PVT behaviour of hydrogen and natural gases through the application of the thermodynamic concepts and equations of state by applying these concepts to selected unit operations,

2. Introduce students to the types of natural gas resources and the economic and social context of their development and also to the latest in the race to produce and use hydrogen on a commercial level.

Course Learning Outcomes

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

Learning Outcome	EA Stage 1 Competencies
1. Apply thermodynamic theory to predict & explain the properties and PVT behaviour of hydrogen and natural gases.	

Learning Outcome	EA Stage 1 Competencies
2. Perform preliminary design/analysis calculations for common unit operations in hydrogen and natural gas handling.	
3. Critically engage in contemporary debates around the development of the various types of natural gas resources and technolgies of hydrogen production.	

Teaching Strategies

Please refer to the information in Moodle

Assessment

Assessment task	Weight	Due Date	Course Learning Outcomes Assessed
1. Quiz 1	25%	08/03/2023 07:00 PM	1, 2, 3
2. Quiz 2	25%	12/04/2023 07:00 PM	1, 2, 3
3. Final Exam	50%	Not Applicable	1, 2, 3

Assessment 1: Quiz 1

Start date: 08/03/2005 05:00 PM
Assessment length: 2 hours
Due date: 08/03/2023 07:00 PM

Quiz 1 includes material covered in the first four weeks, namely introduction to calcilation of various combined compositions (e.g. volume, mass, mole fractions) of natural gas streams, first and second law of thermodynamics.

Assessment 2: Quiz 2

Start date: 12/04/2023 05:00 PM
Due date: 12/04/2023 07:00 PM

Quiz 2 covers material covered from week 6 to week 9, namely behaviour of real gases, cubic equations of state, flow of Natural Gas and hydrogen gases in pipelines, compressors, turbines, hydrates formation.

Assessment 3: Final Exam

Assessment length: 2 hours
Submission notes: The date will be set by the Exams central unit

This is a comprehensive exam covering material covered throughout the Term

Attendance Requirements

To pass this course it is expected that you will attend at least 80% of tutorials and lectures. *Failure to meet the specified attendance requirements of the course may result in in the award of an Unsatisfactory Failure (UF) grade for the Course.*

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 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.

Course Schedule

UNSW Week	Activity	Content
1 **13th Feb**	1x3h lecture, 2x1 h tutorial	Course introduction; hydrogen generation and natural gas resources; energy, heat & work. Getting gas to market (gas specifications and processing)
2 **20th Feb**	1x3h lecture, 2x1 h tutorial	**The first law; state functions & reversible processes; heat effects; heating values; greenhouse gases**
3 **27th Feb**	1x3h lecture, 2x1 h tutorial	**The second law; entropy; ideal & lost work; material, energy and entropy balances**
4 **6th Mar**	1x3h lecture, 2x1 h tutorial	**PVT behaviour of ideal and real gases; reversible cycles for processes**
5 **13th Mar**	1x3h lecture, 2x1 h tutorial	**Real equations of state; residual properties and real processes**
6 **20th Mar**	1x3h lecture, 2x1 h tutorial	**Flexibility week, 5x1 Consultation-Optional**
7 **27th Mar**	1x3h lecture, 2x1 h tutorial	**Onshore transport of natural gas: compressors, turbines and pipelines** **Transport of hydrogen, examples.**
8 **3rd Apr**	1x3h lecture, 2x1 h tutorial	**Vapour-liquid equilibrium and the phase behaviour of natural gases and hydrogen**
9 **10th Apr**	1x3h lecture, 2x1 h tutorial	**Water vapour in natural gases; dehydration and hydrate inhibition**
10 **17th Apr**	1x3h lecture, 2x1 h tutorial	**Hydrogen generation technologies and possibly valves, nozzles and chokes in natural gas operations**

View class timetable

Timetable

Date	Type	Content
Week 4: 6 March - 10 March	Assessment	Quiz 1
Week 9: 10 April - 14 April	Assessment	Quiz 2

Resources

Prescribed Resources

Following is the recommended books for this course.

Smith, van Ness, Abbott, & Swihart (2018) Chemical Engineering Thermodynamics, 8th edition, McGraw-Hill. This is the 'text book' for the course. It is available from the UNSW Bookshop and the UNSW Library (660.28/70).

1.

Recommended Resources

Other Resources (if applicable)

1. Fundamentals of Engineering Thermodynamics by Moran & Shappiro provides a good introduction to thermodynamics and covers much but not all the content covered in this course. The library has 9 copies (621.4021/66).

2. Fundamentals of Natural Gas Processing by Kidnay & Parrish gives a good introduction to the natural gas industry and is available online through the UNSW Library website (http://www.crcnetbase.com/isbn/978-0-8493-3406-1).

Students will be suggested additional handbooks and texts related to particular topics covered in the course.

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 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:

- 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	