

# CHEE 414 / GEOE 414 – FOUNDATIONS OF THE OIL AND GAS INDUSTRY

## Course Syllabus – Winter 2022

### LAND ACKNOWLEDGEMENT

Queen's University is situated on traditional Anishinaabe and Haudenosaunee Territory.  
See: <http://www.queensu.ca/encyclopedia/t/traditional-territories>

### INCLUSIVITY STATEMENT

Queen's students, faculty, and staff come from every imaginable background – small towns and suburbs, urban high rises, Indigenous communities, and from more than 100 countries around the world. You belong here: <https://www.queensu.ca/inclusive/>.

## TEACHING TEAM

### COURSE INSTRUCTOR

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### TEACHING ASSISTANT

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## COURSE INFORMATION

### COURSE DESCRIPTION

Fundamentals of the oil and gas industry covering Chemical Engineering and Geological Engineering practice, and implications of Canadian and world political forces together with business practices are covered. Industry needs for exploration, recovery, processing, business expansion and policy issues will be addressed. Conventional, unconventional oil and gas as well as heavy oil and bitumen will be analyzed. Environmental issues covering, water usage, GHG emissions and energy use will be compared. The course includes three hours of lecture and one hour of tutorial per week. (0/0/0/30/12)

Prerequisites: CHEE 221 or GEOE 238, or permission of the department

### PRE-REQUISITE KNOWLEDGE

This course is designed for learners with some background on the geological, chemical and sustainability issues in the oil and gas industry.

### COURSE LEARNING OUTCOMES (CLO)

By the end of this course, students should be able to:

CLO	Description	Indicator
CLO 1	Analyze global and Canadian energy and hydrocarbon supply and demand within the business and geopolitical context of the industry, current business issues, including taxes and incentives, environmental regulations and policy – including water use and CO <sub>2</sub> emissions.	DE-Define
CLO 2	Examine, distinguish, and relate the six elements of a working hydrocarbon (HC) system, and recognize the geological controls of each element.	KB-ES (Human Interaction with Earth)
CLO 3	Analyse how these geological controls underpin the techniques used for HC exploration and reservoir characterization.	KB-ES (Human Interaction with Earth)
CLO 4	Apply Chemical Engineering principles to design appropriate equipment and facilities for the drilling, completion and production of oil and gas wells.	KB-ES (Process)
CLO 5	Assess the role of horizontal well drilling technology along with both the development of multi-stage hydraulic fracturing and SAGD, and the impact on the production of hydrocarbons in North America. Critique the environmental impacts of these technologies.	KB-ES (Process)
CLO 6	Appraise the different methods for how heavy oil and bitumen are produced, processed and transported along with the environmental issues involved.	KB-ES (Process)

<b>CLO</b>	<b>Description</b>	<b>Indicator</b>
CLO 7	Assess how to optimize regional refinery and gas plant flow plans through an understanding of supply chain systems including pipelines, rail, trucking and ocean tankers in respect to both crude oil, products, natural gas and LNG.	KB-ES (Process)
CLO 8	Recognize the different technical roles in the oil and gas industry and describe the main functions of various careers in relation to exploration, production, processing or business processes through weekly guest lectures.	LL-Acquisition

This course maps to the following program indicators:

### **Knowledge base for engineering (KB)**

**KB-Proc(c)** Applies engineering principles to do engineering calculations and size various unit operations, including pumps, heat exchangers, separation processes, and reactors.

### **Design (DE)**

**DE-Define** Define problem, objectives and constraints, with appropriate attention to health, safety, environmental, economic, regulatory, cultural, societal and stakeholder needs.

## **COURSE EVALUATION**

### **ASSESSMENT WEIGHTING**

<b>Assessment Tool</b>	<b>Due Date (before 23:59 ET)</b>	<b>Weight</b>	<b>Alignment with CLOs</b>
Assignments	Due as directed in OnQ	40%	1, 2, 3, 4, 5, 6, 7
Weekly Quizzes	End of tutorial day for Weeks 2-11	20%	1, 2, 3, 4, 5, 6, 7
Midterm	Week 7	20%	1, 2, 3, 4
Final	As per final exam schedule	20%	1, 4, 5, 6, 7, 8
		<b>100%</b>	

## ASSESSMENT DESCRIPTIONS

### Media Critiques

Several documentaries/videos are available online or in OnQ and students should view outside of class. Links will be provided to these documentaries/videos and the subject material may be tested.

### Assignments

There will be a minimum of eight assignments in the course. These assignments will follow the lecture material and build upon the tutorials.

### Quizzes

There are ten quizzes in the course. The quizzes are comprised of multiple choice and true/false questions that will help to identify gaps in conceptual understanding. These quizzes are taken online (in OnQ) during each lecture at 7:30pm (**NOTE: Possibly taken by “click format”**).

### Mid Term and Final Exam

The Mid Term exam will be held during week 7 and is 90 minutes in length. The final exam is 90 minutes in length. Both exams are open book. Students must write their exam on the day and time scheduled by the University. Avoid scheduling vacations, appointments, etc. during the exam period. The [Term and Session Dates](#) will indicate the final exam period session dates in each term. The test bank is available for students to utilize in preparing for the final exam. There is not a test bank for mid-terms and none will be offered, however a review session may be offered outside of class hours for the mid-term.

### Remote Proctoring – Proctortrack

The midterm and final exams in this course will use remote proctoring provided by a third-party, cloud-based service that enables the completion of a proctored exam or test from an off-campus location, through onQ or Elenra. This online proctoring solution was chosen as part of the approach to maintaining academic integrity in online assessment. Precise details about how remote proctoring will be used in this course can be found in the “Getting Started with Remote Proctoring” content module in onQ or will be provided by the instructor.

When writing tests/exams using remote proctoring, you are connecting to the third-party service. Queen’s has conducted a privacy and security review of the service in accordance with Ontario’s privacy legislation.

You should also take measures yourself to protect your information by keeping your NetID password and challenge questions private, closing all applications prior to starting an exam/test, and ensuring your device is updated and safeguarded against malware.

For more information about remote proctoring, see the Student FAQs on the OUR Exams resource page for remote proctoring.

## LATE POLICY

Any applicable late penalties are described in the details for each assessment. In the event of extenuating circumstances, you may request an extension to an assignment due date without penalty. Requests must be made to your instructor prior to the original due date of the assignment, and some substantiating documentation is often required. Note that unacceptable reasons include malfunctioning computer, travel plans to go home for holidays, generally behind on schoolwork, etc. In the absence of substantiating documentation, the normal late penalty will apply as described in the assignment or departmental policies.

## GRADING

All assessments in this course will receive numerical percentage marks. The final grade you receive for the course will be derived by converting your numerical course average to a letter grade according to the established [Grade Point Index](#).

### Feedback on Assessments

The teaching team will provide feedback on graded activities. You can expect feedback on your assessments within seven days of the due date.

### Accessing Your Final Grade

Your final grades will show on SOLUS. Official transcripts showing final grades will be available on the Official Grade Release Date. Please note that in official transcripts, a mark of IN (incomplete) is considered a grade, and your transcript is released with this grade.

## COURSE MATERIALS

### Required Textbook

- There are no required textbooks for this course, however the following book is strongly recommended as a resource for the course. It is available in e-book format from the library.

Oil: A Beginners Guide, Vaclav Smil, 2017. ISBN: 1851685715

### Required Calculator

- A Casio 991 is required. **ONLY** this type of non-programmable, non-communicating calculator will be allowed during tests and exams.

### Required Hardware/Software

Students must have a reliable [internet connection and hardware](#) that are compatible with online learning and remote proctoring system requirements.

### Other Material

All other course material is accessible via OnQ.

## SUGGESTED TIME COMMITMENT

This course represents a study period of one semester spanning 12 weeks. Learners can expect to invest on average 7-9 hours per week in this course. Learners who adhere to a pre-determined study schedule are more likely to successfully complete the course on time.

## WEEKLY COURSE OUTCOMES

Week	Learning Outcomes
	<p><b>General Introduction and Introduction to the Petroleum Industry</b></p> <p>By the end of this week, learners will be able to:</p>
1	<ul style="list-style-type: none"> <li>Understand the significance of the hydrocarbons globally and in Canada, historically and at present [CLO 1]</li> <li>World markets, basins, historical significance [CLO 1]</li> <li>Have reviewed geologic elements of hydrocarbon systems [CLO 2]</li> <li>Hydrocarbon sources (marine, terrestrial leads to oil/gas) [CLO 2]</li> <li>Kitchen - temperature, pressure, OM evaluation [CLO 2]</li> <li>Gain insight into the technical roles in the oil and gas industry [CLO 8]</li> </ul>
	<p><b>Subsurface, E&amp;P – Making hydrocarbons</b></p> <p>By the end of this week, learners will be able to apply terminology and spatial occurrences related to:</p>
2	<ul style="list-style-type: none"> <li>Seal Types and Hydrocarbon Traps. [CLO 2]</li> <li>Rock Pore Systems (storage and flow properties) [CLO 2]</li> <li>Basin Definition and Formation [CLO 2]</li> </ul>
	<p><b>Subsurface, E&amp;P – Exploring for hydrocarbons</b></p> <p>By the end of this week, learners will be able to define and describe:</p>
3	<ul style="list-style-type: none"> <li>Understand techniques and tools for hydrocarbon exploration [CLO 3]</li> <li>Recognize reservoir types and their formation [CLO 2]</li> </ul>
	<p><b>Subsurface, E&amp;P – Evaluating reservoir presence</b></p> <p>By the end of this week, learners will be able to:</p>
4	<ul style="list-style-type: none"> <li>Describe the working hydrocarbon systems of Western Canada [CLO 3]</li> <li>Demonstrate knowledge and application of sequence stratigraphy [CLO 2, 3]</li> </ul>
	<p><b>Subsurface, E&amp;P – Evaluating reservoir quality</b></p> <p>By the end of this week, learners will be able to define and interpret:</p>
5	<ul style="list-style-type: none"> <li>Understand how well log data is collected and interpreted [CLO 3]</li> <li>Understand how geologic models are created and used [CLO 3]</li> </ul>
	<p><b>Subsurface E&amp;P – Evaluating and producing hydrocarbons</b></p> <p>By the end of this week, learners will understand the following topics:</p>
6	

Week	Learning Outcomes
	<ul style="list-style-type: none"> <li>• The difference between conventional and unconventional resources. [CLO 3, 5]</li> <li>• How pore pressure, permeability and hydraulics influence drilling and extraction for hydrocarbons [CLO 4, 5]</li> <li>• The basic structures and systems of a drilling rig. [CLO 4, 5]</li> </ul>
<b>Oil and Gas Extraction: Drilling</b>	
By the end of this week, learners will be able to:	
7	<ul style="list-style-type: none"> <li>• Understand the key components of a drilling operation and well completion. [CLO 4, 5]</li> <li>• Determine whether surface casing is required for a new well. [CLO 4]</li> <li>• Calculate the required drilling mud density to maintain well control [CLO 4]</li> <li>• Determine the best size and design for a well casing string [CLO 4]</li> </ul>
**Students will write their mid-term examination this week	
<b>Oil and Gas Extraction: Completions and Hydraulic Fracturing</b>	
By the end of this week, learners will be able to:	
8	<ul style="list-style-type: none"> <li>• Discuss the key reasons for well stimulation and the types. [CLO 4, 5]</li> <li>• Calculate the optimal tubing size for a gas well completion [CLO 4, 5]</li> <li>• Understand hydraulic fracturing in horizontal wells and the complexity of variables determining outcomes. [CLO 4, 5]</li> <li>• Understand the main drivers of fluid flow dynamics in a horizontal well [CLO 4, 5]</li> </ul>
<b>Extraction – Production of conventional oil and gas</b>	
By the end of this week, learners will be able to:	
9	<ul style="list-style-type: none"> <li>• Understand how to calculate inflow performance of wells [CLO 4, 5]</li> <li>• Determine critical gas rates, production decline curves and identify deviations. [CLO 4, 5]</li> <li>• Be able to describe the complexities of multiphase flow in long horizontal wells. [CLO 4, 5]</li> <li>• Compare methods for evaluating well production and problem identification. [CLO 4, 5]</li> <li>• Be able to determine the correct type of artificial lift for oil and gas wells [CLO 4, 5]</li> </ul>
<b>Extraction – Production Measurement, Reservoir, EOR, Natural Gas Processing</b>	
By the end of this week, learners will be able to:	
10	<ul style="list-style-type: none"> <li>• Understand oil and gas measurement methods and be able to calculate basic flow calculations [CLO 4, 5]</li> <li>• Understand secondary and tertiary enhanced oil production methods and how they are applied [CLO 4, 5]</li> </ul>

Week	Learning Outcomes
	<ul style="list-style-type: none"> <li>• Be able to describe the key components in a gas plant design [CLO 4]</li> </ul>
11	<p><b>Extraction – Heavy Oil Mining In-Situ production and upgrading;</b></p> <p>By the end of this week, learners will be able to:</p> <ul style="list-style-type: none"> <li>• Discuss and differentiate the two major types of oil sands production (mining, SAGD) [CLO 5, 6]</li> <li>• Understand the oil sands mining process, advantages and disadvantages including water usage. [CLO 1, 6]</li> <li>• Critique oil sands steam assisted gravity drainage (SAGD), well design, steam ratios, steam plants and water usage. [CLO 1, 5, 6]</li> </ul>
12	<p><b>Upstream Processing; Refining, Transportation and Industry Emission Concerns</b></p> <p>By the end of this week, learners will be able to:</p> <ul style="list-style-type: none"> <li>• Assess the different types of refineries, why they are different, along with the feedstocks and products of each. [CLO 6, 7]</li> <li>• Explain the economics of the various grades of oil [CLO 7]</li> <li>• Know why conversion units of different types, dewaxing, isomerization, and sulfur removal units are required [CLO 6, 7]</li> <li>• Discuss the main transportation methods for oil and gas (pipelines, rail, ship) [CLO 1, 7]</li> <li>• Discuss the key environmental issues; policy, regulatory and other boundaries governing industry activity [CLO 1, 5]</li> <li>• Identify issues in fossil fuel consumption including taxation for individuals, municipalities, and governments [CLO 1]</li> </ul>

## COURSE COMMUNICATION

### NETIQUETTE

In this course, you may be expected to communicate with your peers and the teaching team through electronic communication. You are expected to use the utmost respect in your dealings with your colleagues or when participating in activities, discussions, and online communication.

Following is a list of netiquette guidelines. Please read them carefully and use them to guide your online communication in this course and beyond.

1. Make a personal commitment to learn about, understand, and support your peers.
2. Assume the best of others and expect the best of them.
3. Acknowledge the impact of oppression on the lives of other people and make sure your writing is respectful and inclusive.
4. Recognize and value the experiences, abilities, and knowledge each person brings.
5. Pay close attention to what your peers write before you respond. Think through and re-read your writings before you post or send them to others.



6. It's alright to disagree with ideas, but do not make personal attacks.
7. Be open to be challenged or confronted on your ideas and challenge others with the intent of facilitating growth. Do not demean or embarrass others.
8. Encourage others to develop and share their ideas.

## QUESTIONS ABOUT COURSE MATERIAL

Questions or comments regarding the course material that can be of benefit to other students should be posted in the Q&A forum on the class website. The instructor, TAs, and students are encouraged to answer these questions directly in the discussion forum for the benefit of everyone in the course.

## COURSE ANNOUNCEMENTS

The instructor will routinely post course news in the Announcements section on the main course homepage on OnQ. Please sign up to be automatically notified by email when the instructor posts new information in the Announcements section. Instructions on how to modify your notifications are found in the **Begin Here** section of the class website.

## OFFICE HOURS

In addition to interaction in the Q&A discussion forums, you will have the opportunity to interact in a synchronous fashion with either a TA or the instructor through office hours. The instructor will provide a schedule of availability at the beginning of the term.

## CONFIDENTIAL MATTERS

If you have a confidential matter you would like to discuss with your instructor, their contact details are on the first page of this document. Expect email replies within 48 hours.

## RECORDING SYNCHRONOUS (LIVE) CLASSES

Synchronous (live) classes may be delivered in this course through a video conferencing platform supported by the University [MS Teams, Zoom]. Steps have been taken by the University to configure these platforms in a secure manner, and to maintain student privacy while delivering courses remotely. Please note the following:

- Lectures will be recorded with video and audio (and in some cases transcription) and will be made available to students in the course for the duration of the term. You will be able to turn off your camera and microphone if you would like... **[edit as appropriate]**
- Tutorials **[will/will not]** have mandatory participation, and **[will/will not]** be recorded with video and audio...

The recordings may capture your name, image or voice through the video and audio recordings. By attending these live classes, you are consenting to the collection of this information for the purposes of administering the class and associated coursework. If you are concerned about the collection of your name and other personal information in the class, please contact the course instructor to identify possible alternatives.

To learn more about how your personal information is collected, used and disclosed by Queen's University, please see the general [Notice of Collection, Use and Disclosure of Personal Information](#).

## COURSE POLICIES

Please review the following policies concerning copyright, academic integrity, absences and academic accommodations:

### COPYRIGHT

Course materials created by the course instructor, including all slides, presentations, synchronous and asynchronous course recordings, handouts, tests, exams, and other similar course materials, are the intellectual property of the instructor. It is a departure from academic integrity to distribute, publicly post, sell or otherwise disseminate an instructor's course materials or to provide an instructor's course materials to anyone else for distribution, posting, sale or other means of dissemination, without the instructor's *express consent*. A student who engages in such conduct may be subject to penalty for a departure from academic integrity and may also face adverse legal consequences for infringement of intellectual property rights and, with respect to recordings, potentially privacy violations of other students.

### ACADEMIC INTEGRITY

As an engineering student, you have made a decision to join us in the profession of engineering, a long-respected profession with high standards of behaviour. As future engineers, we expect you to behave with integrity at all times. Please note that Engineers have a duty to:

- Act at all times with devotion to the high ideals of personal honour and professional integrity.
- Give proper credit for engineering work

The standard of behaviour expected of professional engineers is explained in the [Professional Engineers Ontario Code of Ethics](#). Information on policies concerning academic integrity is available in the [Queen's University Code of Conduct](#), in the [Senate Academic Integrity Policy Statement](#), on the [Faculty of Engineering and Applied Science website](#), and from your instructor.

Departures from academic integrity include plagiarism, use of unauthorized materials or services, facilitation, forgery, falsification, unauthorized use of intellectual property, and collaboration, and are antithetical to the development of an academic community at Queen's. Given the seriousness of these matters, actions which contravene the regulation on academic integrity carry sanctions that can range from a warning or the loss of grades on an assignment to the failure of a course to a requirement to withdraw from the University.

In the case of online or remotely proctored exams, impersonating another student, copying from another student, making information available to another student about the exam questions or possible answers, posting materials to online services, communicating with another person during an exam or about an exam during the exam window, or accessing unauthorized materials, including internet sources and using unauthorized materials, including smart devices, are actions in contravention of academic integrity.

## LATE POLICY

Any applicable late penalties are described in the details for each assessment. In the event of extenuating circumstances, you must follow the policies for requesting an academic consideration (please see below). Note that unacceptable reasons include extra-curricular activities, travel plans, generally behind on schoolwork, etc. In the absence of an approved consideration request, the normal late penalty will apply as described in the assignment or any course/departmental policies.

## INVALID EXAMS

An exam may be declared invalid in case of an interruption in an in-person examination; if the instructions in a remote or online exam were not followed; if the student uploads wrong materials; or if a situation arises where the integrity of the exam cannot be verified. If an exam is declared invalid, the student may be granted a re-write.

## ABSENCES (ACADEMIC CONSIDERATION) AND ACADEMIC ACCOMMODATIONS

For absences and academic accommodations please review the information on the [FEAS website](#).

# ACADEMIC AND STUDENT SUPPORT

## INDIVIDUAL NEEDS AND SUPPORT

If you have a disability or health-related condition that may require academic accommodations, please approach the [Queen's Accessibility Services](#). The staff at Accessibility Services are available by appointment to develop individualized accommodation plans, provide referrals, and assist with advocacy. The sooner you let us know your needs, the better we can assist you in achieving your learning goals. For questions or assistance with requesting Academic Consideration or Accommodation, contact the FEAS Academic Accommodation Coordinator at [engineering.aac@queensu.ca](mailto:engineering.aac@queensu.ca)

Every effort has been made to provide course materials that are accessible. For further information on accessibility compliance of the educational technologies used in this course, please consult the links below.

EDUCATIONAL TECHNOLOGY	ACCESSIBILITY COMPLIANCE INFORMATION
onQ (Brightspace Learning Management System by D2L)	<a href="https://www.d2l.com/accessibility/standards/">https://www.d2l.com/accessibility/standards/</a>
MS-Teams	<a href="https://support.microsoft.com/en-us/office/accessibility-support-for-microsoft-teams-d12ee53f-d15f-445e-be8d-f0ba2c5ee68f">https://support.microsoft.com/en-us/office/accessibility-support-for-microsoft-teams-d12ee53f-d15f-445e-be8d-f0ba2c5ee68f</a>

If you find any element of this course difficult to access, please discuss with your instructor how you can obtain an accommodation.

### **ACCOMMODATIONS RELATED TO REMOTE ASSESSMENT**

To have your accommodations applied to a remote-proctored exam please follow the instructions for submitting your information, as outlined on the QSAS website. Your accommodations will be incorporated into your exam session by the Queen's University exam coordinators, on behalf of your course instructor. This information is uploaded automatically to [Proctortrack / Examity](#).

If you are already registered with QSAS and you require additional accommodations related to remote-proctored exams, please consult with your QSAS advisor to update your Letter of Accommodation as appropriate.

### **RELIGIOUS OBSERVANCE**

Students in need of accommodation for religious observance are asked to speak to their professor within a week of receiving their syllabus. Note also that alternative assignments are considered a "reasonable accommodation" under the Ontario Human Rights Code. Students with questions about their rights and responsibilities regarding religious accommodation should contact Chaplain Kate Johnson via [Chaplain@queensu.ca](mailto:Chaplain@queensu.ca).

### **TECHNICAL SUPPORT**

Some basic comfort level with basic hardware and software skills are required for this course. If you require technical assistance, please contact [Technical Support](#).

### **SUPPORTIVE PERSONAL COUNSELLING**

If at any time you find yourself feeling overwhelmed, anxious, sad, lonely, or distressed, consider confidential supportive counselling offered by the [embedded counselors](#) at the Student Wellness Service Faculty of Engineering and Applied Science.