MEEN 4810.011

Topics in Mechanical and Energy Engineering

Oil and Gas

Spring 2019

Course description: Overview of the petroleum industry and petroleum engineering including nature of oil and gas reservoirs, petroleum exploration and drilling, formation evaluation, completion and production, surface facilities, reservoir mechanics, and improved oil recovery. The course will also provide information about fuels and refining processes.

Catalog Description: The course provides an overview and history of the oil and gas industry and petroleum engineering, including nature of oil and gas reservoirs, petroleum exploration and drilling, formation evaluation, well completions and production, surface facilities, reservoir mechanics, and improved oil recovery. It introduces the importance of ethical, societal, and environmental considerations and current events on activities in the petroleum industry.

Prerequisite(s): Consent of instructor.

Textbook: Introduction to Petroleum Engineering
John R. Franchi and Richard L. Christiansen
Wiley 2017, 335 Pages
ISBN 9781119193449


Course objectives: Course objectives are: (1) to provide students with fundamental concepts in petroleum engineering; (2) introduction to petroleum industry organization and opportunities; (3) introduction to up-stream exploration and production, mid-stream, and down-stream industry activities; (4) to highlight key engineering problems and solutions relevant to the energy industry sector.
Learning outcomes:

1. Develop knowledge of engineering practices in the petroleum industry
2. Fundamental concepts in petroleum engineering
3. Ability to identify, formulate, and solve engineering problems
4. Where do you begin to explore for oil and gas?
5. Exposure to petroleum geology and geophysics
6. Develop knowledge of drilling, reservoir, and production engineering
7. Develop knowledge of energy resources in the DFW area and Texas
8. Exposure to enhanced recovery technology which is applied in the DFW area
9. Exposure to technical software tools that are applied in the industry
10. Develop knowledge of industrial practices in the oil and gas sector
11. Relationship of business economics to technical work
12. Relationship of industry practices and environmental concerns

Course content:

1. Introduction
   1.1. Historical Perspective
   1.2. Nature of Oil & Gas
   1.3. U.S. and Global Energy Production and Demand

2. Fuels
   2.1. Classification
   2.2. Energy Systems
   2.3. Stoichiometry and Thermodynamics

3. Petroleum Geology and Geophysics
   3.1. Basic Geology
   3.2. Petroleum Geology
   3.3. Petroleum Geophysics
   3.4. DFW Earthquake Exercise
   3.5. UNT Magnetic Field Exercise
   3.6. Seismic Velocity Exercise
   3.7. Seismic Frequency/Wavelength Exercise
   3.8. Seismic Interpretation Exercise

4. Petroleum Exploration
   4.1. Petroleum Exploration
   4.2. Tools and Techniques
   4.3. Mineral Rights and Leasing
   4.4. Lease Sale Exercise
   4.5. DFW Wells Exercise

5. Drilling
   5.1. Rotary Rig Basics
   5.2. Mud Systems
   5.3. Directional Drilling
   5.4. Drill String Loads Exercise
5.5. Finite Element Analysis of Drill Pipe Section
5.6. Strength of Materials vs Drill String Formula Validation
5.7. Drill String Pipe Specification Exercise
5.8. Units Conversion Issues

6. **Formation Evaluation**
   6.1. Mud Logging
   6.2. Well Logging
   6.3. Drillstem Tests
   6.4. Core Analysis

7. **Completions**
   7.1. Casing Design
   7.2. Cementing
   7.3. Completion Techniques
   7.4. Adina Finite Element Software Tutorial
   7.5. Implementation of Loads and Boundary Conditions for a Drilled Hole
   7.6. Finite Element Analysis of Uncased Hole Exercise
   7.7. Finite Element Analysis of a Cased Hole Exercise

8. **Reservoir Engineering**
   8.1. Material Balance
   8.2. Decline Curve Analysis
   8.3. Immiscible Displacement & Water-flooding
   8.4. EOR Techniques

9. **Production Engineering**
   9.1. Inflow Performance
   9.2. Well Stimulation Techniques
   9.3. Artificial Lift

10. **Unconventional Sources**
    10.1. Oil Sands
    10.2. Oil Shale
    10.3. Shale Gas (“Fracking”)
    10.4. Methane Hydrates

11. **Transportation and Refining**
    11.1. Transportation and Storage
    11.2. Refining and Processing
    11.3. Gas Processing
    11.4. Petrochemicals

12. **Topical Issues**
    12.1. Petroleum Economics
    12.2. Peak Oil Theories
    12.3. Environmental, Health and Safety Concerns
    12.4. Energy Options and Policy

**Course format:** 3 hours of lecture per week; Tuesday & Thursday 3:30 – 4:50 PM.

**Classroom:** F175

**Office hours:** F102F, Tues. & Thurs. 2:30 – 3:30 PM, or By Appointment

**Attendance:** Class attendance is required.
In-Class Behavior: Inappropriate behavior such as talking out loud, walking in front of the instructor during a lecture to turn in an assignment, or other disruptions will not be tolerated. Students who exhibit this behavior will be asked to leave the classroom. Please be considerate of students who are trying to learn the material. Please review the “UNT Code of Student Conduct” for guidelines on acceptable behavior.

Homework & In-Class Exercises: Homework and in-class exercises must be completed in a neat, professional manner. Students must work on in-class exercises during the allotted class time when the instructor is available to answer questions. All items turned in must have the student’s name, student number, and the date the exercise was assigned. Assignments with multiple pages must be secured with a staple. An example assignment in the required format will be presented the first day of class. Homework in the required format may be submitted via email in PDF format. Homework is due before the beginning of class one-week subsequent to the assignment date. In-class exercises are due at the end of the class they were assigned and will be graded based on relative performance (curved). No late homework or in-class exercise materials will be accepted. Once homework and in-class exercises are graded they will be carried to two subsequent lectures for return to students. Students are encouraged to work together on homework assignments however each individual student must complete assignments independently and turn in their own work and calculations. Homework is part of the grade for this course so copying of assignments is a form of academic dishonesty!!!

Grading:

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<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Homework, quizzes, in-class exercises</td>
<td>30%</td>
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<tr>
<td>Midterm exam</td>
<td>30%</td>
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<tr>
<td>Final exam</td>
<td>35%</td>
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<tr>
<td>Class Participation</td>
<td>5%</td>
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<tr>
<td>Total</td>
<td>100%</td>
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Class participation will be checked with random attendance sign-in sheets and quizzes. Students who do not attend class and miss in-class assignments, quizzes, or attendance sign-in will receive a grade of 0 for that assignment, quiz, or participation day.

Academic Honesty: Students are encouraged to work together on homework and in-class exercises. However, all work turned in must be your original work. Students caught cheating are subject to disciplinary action by the University. Some examples of cheating follow:

1. Copying someone else’s homework or in-class exercise.
2. Manipulation of attendance records (Leaving class after signing in or showing up at the end of class and signing in).
3. Copying another student’s exam answers.
Disabilities accommodation: The University of North Texas complies with Section 504 of the 1973 Rehabilitation Act and with the Americans with Disabilities Act of 1990. The University of North Texas provides academic adjustments and auxiliary aids to individuals with disabilities, as defined under the law. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring accommodation, please see the instructor and/or contact the Office of Disability Accommodation at 940-565-4323 during the first week of class.

Instructor: Dr. Richard J. McMullen, Jr
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