ES486 PETROLEUM GEOLOGY
POLICIES AND PROCEDURES
Winter Term 2017 - Western Oregon University
4 CR TR 2:00 - 3:50 PM Natural Sciences Bldg, Rm 218

INSTRUCTOR: Dr. S. Taylor OFFICE: RM 210 Natural Sciences Bldg

OFFICE HOURS: M 2-4 PM; W,F 12-1 PM
By Appointment

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COURSE DESCRIPTION:

This course provides an introduction to the principles of petroleum geology and methods used for discovery of oil in the subsurface environment. Topics include historical overview, properties of oil and natural gas, geologic environments, generation and migration, reservoir properties, traps and seals, methods of exploration, drilling techniques and extraction, and case studies of classic petroleum producing regions of the world. Laboratory activities include geologic map interpretation, well log analysis, geophysical methods and quantitative approaches to geologic problem solving. Four hours of lecture and active learning per week. Supplemental field trips are incorporated as needed. *Prerequisites: ES 201, ES 202 or consent of instructor.*

COURSE GOALS AND LEARNING OBJECTIVES:

ES486 learning objectives are aligned with WOU Earth Science program outcomes and select components of the LEAP (Liberal Education and America's Promise; http://aacu.org/leap) learning outcomes developed by the Association of American Colleges and Universities. Upon successful completion of ES202 Principles of Geology, students will be able to demonstrate minimum competency in the following program areas:

1. Demonstrate knowledge of the geological conditions that lead to the accumulation of petroleum.
2. Apply algebraic, trigonometric, and statistical principles to geologic data collection and analysis.
3. Associate geologic environments with petroleum producing regions of the world.

TEXT AND READING:

Selley and Sonnenberg, 2014, **Elements of Petroleum Geology (3rd Ed.)**: Elsevier, 470 p.
Text readings, handouts, online resources, journal articles and lab exercises will be provided by instructor.

THE PROFESSOR'S PHILOSOPHY ON UPPER DIVISION EARTH SCIENCE / GEOLOGY COURSES:

The upper division Earth Science / Geology course sequence is designed for mature, serious students who are willing to work hard, play hard, have fun, and learn in-depth skills / concepts in a professional academic setting. By default, our student population is very diverse with a wide array of skills, interests, and career goals. The student population ranges from serious Earth Science majors with focused career objectives, to Geology / Earth Science minors to Science Education majors. As such, the professor is charged with serving a diverse array of student interests and career goals in the most professional manner possible. The problem-solving and technical skills acquired via training in the Earth Sciences are highly valuable (and marketable), regardless of career track. Students are expected to actively participate in the learning process and make a significant contribution to the academic integrity of the Earth Science program at Western Oregon University. The ultimate goal of the program is to provide graduates with the academic skills that will enable them to be highly competitive in graduate school or the career marketplace. *GO TEAM!*

CLASS NOTES:

A comprehensive set of instructor class notes are available for download via the internet. The class web site is at URL http://www.wou.edu/taylor ... and follow the links to the "ES486" home page.

The class notes are available as Adobe Acrobat Reader files (*.pdf file). Acrobat Reader is free and is installed on many campus PC's. For home installation, Acrobat Reader is also available for download at the class web site, but you will be responsible for properly installing the software.

Based on prior student suggestions, I have assembled my class notes and made them available. These notes may be freely printed at any campus internet station (e.g. ITC Bldg - Student Lab, Library, local department computer labs). The notes are in outline form and are very comprehensive. "Exam Study Guides" will also be posted on the web site as the term progresses.

EVALUATIONS AND EXPECTATIONS:
Student performance will be evaluated on the basis of 2 exams (Mid-term, Final), weekly lab exercises and student presentations. The following is a breakdown of evaluation points, dates, and letter grades:

Mid-Term Exam	100 pts
Final Exam	125 pts
Class Activities / Lab Exercises	120 pts
Student Presentations	30 pts
TOTAL:	375 pts

Final Grading Scale

Percent Range of Total Points	Letter Grade	Percent Range of Total Points	Letter Grade
94-100%	A	77-79%	C+
90-94%	A-	73-76%	C
87-89%	B+	70-72%	C-
83-86%	B	67-69%	D+
80-82%	B-	63-66%	D
		60-62%	D-
		<60%	F

Exams: Exams will be administered at evenly spaced increments throughout the term; the final will be 20% comprehensive with test material drawn from throughout the term. Exams will largely consist of essay questions and homework-type problems. *Warning: the exams are very comprehensive and will likely require a full 2+ hours to complete, please plan accordingly*.
SPECIAL NOTE ON EXAM ANSWERS: Never use “etc.” in an essay or short answer on an exam. This means nothing in terms of demonstrating your content knowledge. Sketches and drawings help support your written word.

Make-Up Exams: Under NO circumstances will make-up exams be administered without prior arrangement (at least five days) and good reason. Please show up on exam day!

Class and Lab Assignments: Class and lab assignments will be worked BOTH during class time and outside of class time each week. You will have lab, reading, and homework assignments that **may** take up to 3 or 4 hours to complete outside of class time, maybe more in some cases, depending on your skill levels and ability. Please plan your schedule accordingly. Due dates for class exercises will be prescribed by the instructor. Late work will be accepted up to 1 week after the due date, but will be automatically assessed a penalty of -20% of the point total.

Due to the volume of students assigned to the instructor each term, he will not be able to grade the lab exercise work in detail. The homework and lab assignments will be checked for completeness, with questions randomly chosen for content and accuracy. Grade points will be assigned on the basis of these two criteria. Exercise answer keys will be posted on the class web site by the instructor. **It is your responsibility to: (1)**

check your work against the lab / homework keys, (2) make sure you understand how to complete the exercises, (3) find help if you have trouble with lab exercises, and (4) study / learn the exercise skills and material for the exams.

A Note About Incompletes: No incomplete grades will be given during the last week of class. If you have a problem that warrants an incomplete, make arrangements prior to the last week (no exceptions!!).

Learning Resources and Grade Outcomes: The class knowledge base will be derived from a combination of the following: (1) independent student reading outside of class; (2) independent student engagement of take-home lab exercises and quantitative problem solving; (3) independent student reading of web resources linked from the class web site; (4) systematic review and memorizing of class notes and ancillary reading materials, as directly linked from class web site and handed out in hard copy during class time; and (5) successful attendance, note taking, and engagement of in-class lectures delivered by the instructor. Instructor lectures are designed as interpretive translations to assist students in understanding the class content and to stay on track with the weekly schedule. Lectures are not intended as the primary knowledge transfer mechanism. Independent student engagement of readings, class notes and lab work outside of class time is the most important pathway to success.

ANOTHER NOTE ABOUT LAB EXERCISES:
Lab exercises will be quantitative in nature with an expectation that students have or will develop skills in the areas of applied algebra and trigonometry. Students will learn computer applications with emphasis on data analysis and problem solving in the Earth sciences. As such, lab exercises will require an additional time commitment outside of the scheduled weekly meeting (i.e. you will have "homework" and "projects" to work on outside of the scheduled class time).

FIELD TRIP(S):
Local field trips and field exercises may be scheduled during the term as time permits. Please be aware that additional scheduling and personal time may be required as the course develops. This is a work in progress, depending on schedules.

STUDENT HONOR POLICY:
Plagiarism and cheating will not be tolerated. Cheating includes copying others work and using cheat sheets on exams. However, students are encouraged to interact in small groups during class assignments, i.e. you can freely discuss concepts in all portions of the class, except exams.

OTHER REQUIRED MATERIALS:
Students will also need access to a scientific calculator, colored pencils, ruler, and protractor. You will be required to use these materials during lecture, lab, and exams. Please plan accordingly, or you will have trouble successfully completing the class. Computer access and Microsoft Office (Word, Excel, Powerpoint) will be required to complete lab exercises.

STUDENTS WITH DISABILITIES:
Any student who has a disability that requires accommodation, please make an appointment to see me.

A NOTE ABOUT THE LAST WEEK OF CLASS:
Given that the Oregon University System employs the "quarter method" of academic scheduling, upper division courses are by nature "compressed" with much detailed information to cover in a relatively short period of time. Please note that most upper division text books are geared for courses at universities with a 16 week semester system (i.e. we are truly trying to pack 100 gallons of oil in a 55-gal drum). As such, the 10th week of class is as critical to content coverage as the 1st week. Students should anticipate a full slate of "normal" activities during the last week of class, including lectures, lab exercises, written reports, etc. The class is not over until after the final exam! **Plan your schedule accordingly!**

A NOTE ABOUT LOST OR MISSING WORK:
The instructor will only grade work that is received and physically visible. Any missing work (lab assignments, homework, quiz/test answer sheets) will receive a "0" on the grade sheet. This policy applies to work lost by the student or instructor. If the student demonstrates that the work was turned in, but is missing due to the instructor's error, then the student will be afforded an opportunity to make up the work and resubmit it for graded credit. Otherwise, the student will not receive credit for lost or missing work.

CHANGE OF SYLLABUS - POP QUIZZES - UNANNOUNCED HOMEWORK ASSIGNMENTS:
The instructor reserves the right to modify the syllabus and class schedule at any time during the term. Students will be notified of such changes in a timely manner. The instructor also reserves the right to administer pop-quizzes and assign unscheduled homework / class assignments at any time. All students will be responsible for completing this work and it will comprise part of the final class grade.

DIGITAL LAB REPORTS: Weekly lab exercises represent a significant component of the class. Exercises are based on scientific observation, data analysis, and problem solving. Students will compile a Digital Lab Report consisting of a well-organized Acrobat *.PDF file containing completed lab exercises. Students will complete approximately one (1) long-format lab exercise per week of the term, multiple short-format "in-class" exercises, and reading/field trip summaries. Some of the completed work will be in digital format that can easily converted to a *.PDF file directly using Windows 7 tools or Creative Suite Adobe Acrobat software available in the NS218A computer lab. Other lab work that is completed by hand/pencil/paper will be digitally captured by students using scanners in the NS218A computer lab or other available resources on campus. All individual lab exercises and summaries will be converted to PDF formats and combined with the others in the prescribed order, and assembled into one, single, merged PDF Digital Lab Report and uploaded to the Moodle Online Class Management System (online.wou.edu). Portfolio checklists will be provided before the midterm and final times, so that students can organize, assemble and label their portfolio sections in an orderly manner. The order of portfolio sections must follow the assigned check list!

Digital Lab Reports will be graded once at Midterm and once at Final time. A total of four Moodle upload submissions will be scheduled at even increments throughout the term: Week 2 Moodle Test Upload, Week 4 Digital Lab Report 1, Week 8 Digital Lab Report 2, and Week 11 Final Lab Report. Lab reports will be checked for completeness and formatting at the prescribed due dates. An exercise task-list will be maintained as assignments evolve throughout the term. It is important to complete assignments on schedule, as they are designed to help students understand lecture concepts and aid in successfully achieving positive results on the exams.

Special Note: ***Do not use the Adobe Acrobat "Assemble Portfolio" tool.*** This tool appends all of the PDF documents as separate sub-files in random order. When combining PDF documents, the result should be one seamless PDF file, in the order prescribed, with no additional sub-menu management necessary. Any "Adobe Acrobat Portfolios" submitted in the improper format will be returned without grade for subsequent correction and resubmission.

INSTRUCTOR TIMELINE FOR GRADING EXAMS AND LAB MATERIALS:
The instructor's class grades are due the Tuesday after final's week. All exams, lab materials, and assignments submitted by students throughout the term will be graded by that time, however the professor will make an effort to return graded materials within two weeks of the assigned due date.

TENTATIVE CLASS SCHEDULE: This outline should be considered tentative at best. The following schedule may be modified as class ideas evolve throughout the term. Readings are from Selley textbook, Elements of Petroleum Geology or as otherwise noted.

Week	Dates	Class Content	Lab	Reading
1	Jan. 10,12	Introduction / Historical Perspectives	Intro Quantitative Methods Review of Sedimentary Rocks	Ch. 1
2	Jan. 17,19	Properties of Oil and Natural Gas *Moodle Test Upload Due Friday Jan. 20*	Sedimentary Environments	Ch. 2
3	Jan. 24,26	Environments / Petroleum Generation	Fluid and Rock Properties	Ch. 4-5
4	Jan.31,Feb. 2	Principles of Fluid Flow and Migration *Digital Lab Report 1 / Moodle Upload Due Friday Feb. 3*	Lithologic Analysis	Ch. 5
5	Feb. 7,9	Reservoir Properties and Characterization *Exam 1 – Thursday Feb. 9*	Stratigraphic Principles	Ch. 6
6	Feb. 14,16	Petroleum Traps and Seals	Well Log Analysis	Ch. 7
7	Feb. 21,23	Methods of Exploration *Friday Feb. 24 – Last Day to Drop Classes w/o Penalty*	Well Log Analysis	Ch. 3
8	Feb.28,Mar.2	Development and Production **NO CLASS MARCH 2 – Cyber Thursday Assignment** *Digital Lab Report 2 / Moodle Upload Due Friday Mar. 3*	Structural Analysis	Handouts
9	Mar. 7,9	Sedimentary Basins and Petroleum Systems	Basin Analysis	Ch. 8; Journal Articles TBD
10	Mar. 14,16	Case Studies / Regional Basin Analysis	Student Presentations	Ch. 8-9; Journal Articles TBD
11	Mar. 20-24	*Finals Week (check schedule)* *Final Digital Lab Report / Moodle Upload Due Monday March 20*		

ES486 Tentative Assignment Checklist – To Be Finalized as the Term Progresses

Task 1-1. Introduction to Quantitative Analysis and Problem Solving
http://www.wou.edu/las/physci/taylor/es486_petro/Intro_quant_exercise.pdf

Task 2-1. Earth Revealed Intro to Sedimentary Rocks Video Exercise
http://www.wou.edu/las/physci/taylor/es486_petro/sed_videx.pdf

Task 2-2. Review of Sedimentary Rocks Lab Exercise
http://www.wou.edu/las/physci/taylor/es486_petro/Lab_Sed_Rocks_Review.pdf

Task 3-1. In-Class Exercise: Physical Properties of Fluids
http://www.wou.edu/las/physci/taylor/es486_petro/Phys_subsurface_pressure_exercise.pdf

Task 3-2. Introduction to Engineering Principles and Rock Properties Exercise (Q. 1,2,3,4,5,7,8,9,11,21,23)
http://www.wou.edu/las/physci/taylor/es486_petro/intro_engineering_properties_exercise.pdf

Task 4-1. Keyword Review Exercise: Sedimentology, Stratigraphy, Sedimentary Basins
http://www.wou.edu/las/physci/taylor/es486_petro/key_word_search_strat_sed.doc

Task 4-2. Review of Sedimentary Structures, Facies and Environments Lab
http://www.wou.edu/las/physci/taylor/es486_petro/Lab_Sed_Strat_Review.pdf

Task 4-3. In-Class Exercise: Application of the Ideal Gas Law to Natural Gas Extraction
http://www.wou.edu/las/physci/taylor/es486_petro/class_ex_ideal_gas_law.pdf

Task 5-1. Lab Exercise - Fritz and Moore Chapter 2, Stratigraphic Principles and Lithologic Correlation (Key Concept focus pages: p. 25, p. 27, p. 29, p. 37, p. 40) (Lab Exercises to Complete: Exercise 2.2 p. 44, Exercise 2.3, p. 45, Exercise 2.4 p. 46, Exercise 2.5 p. 47)
http://www.wou.edu/las/physci/taylor/es486_petro/Fritz_Moore_Strat_Chap2_Correlation.pdf

Task 5-2. Lab Exercise – Fritze and Moore Chapter 5, Stratigraphic Correlation Part 2 (Use the lithologic symbols on p. 125 to scale draw the three stratigraphic columns in Exercise 5.5.1 on p. 145-146; Complete steps 1-7 as outlined)
http://www.wou.edu/las/physci/taylor/es486_petro/Fritz_Moore_Strat_Chap5_Strat_Columns.pdf

Task 7-1. In-Class Activity: Isopach Mapping of McKenzie River Fan
http://www.wou.edu/las/physci/taylor/es486_petro/in_class_isopach_willamette_aquifer_mckenzie_fan.pdf

Task 7-2. In-Class Activity: Subsurface Geology Inferred from Well Data
http://www.wou.edu/las/physci/taylor/es486_petro/Activity_8D_well_log_cross_sections.pdf

Task 7-3. Paleofacies Reconstructions (exercise 7.1.3 p. 176; ex. 7.2.3 p. 182; ex. 7.3.1 p. 187; ex. 7.3.2 p. 187)
http://www.wou.edu/las/physci/taylor/es486_petro/Fritz_Moore_Strat_Chap7_Facies_Maps.pdf

Task 7-4. Strater Software Tutorial (Lessons 1-8 Inclusive; note assignment addition to include all 8 lessons)
http://www.wou.edu/las/physci/taylor/es486_petro/Strater4_Users_Guide_Preview.pdf

Task 8-1. In-Class Structure Contour Exercise (R & D Structure Lab Manual)
http://www.wou.edu/las/physci/taylor/es486_petro/structure_contour_in_class.pdf

Task 8-2. Structure Contour / Isopach Lab (Exercise 1, 2, 3)
http://www.wou.edu/las/physci/taylor/es486_petro/Structure_contour_mapping.pdf

Task 9-1. Hydrocarbon Production and Recovery Reading Review Questions
http://www.wou.edu/las/physci/taylor/es486_petro/Key_Word_Search_Recovery_Production.docx

Task 9-2. Wireline Geophysics / Well Log Correlation Lab (Activity 1 and 2)
http://www.wou.edu/las/physci/taylor/es486_petro/Intro_Well_Logs_Lab.pdf

Task 10-1. Student Case Study Presentations 10-minute powerpoint case study/journal article summary and one page written summary handout.
http://www.wou.edu/las/physci/taylor/es486_petro/ES486_winter_2015_student_presentations.pdf

Task 10-2. One Page (500 word) Written Summary of Anadarko Basin Case Study Using Wireline Geophysics
http://www.wou.edu/las/physci/taylor/es486_petro/Case_Study_Wireline_Geophys_Anadarko_Basin.pdf