ES486 Petroleum Geology Mid-Term Exam Study Guide
Winter 2017

Exam Format

Two-Part Exam, Tuesday February 14, 2017

Part 1 - Closed Book, short answer essay – terms and definitions, draw sketches, long answer essay – "compare and contrast", "discuss", "explain".

Part 2, Open Book, lab-style problem solving, you will be able to use all of your class resources to solve math-based, lab-style problems.

Study Tips

- go through the web site, look at the figures and slide shows, compare to notes
- review the video resources and exercise review sheets
-review textbook summary questions / answers
- use study guide in combination with notes
- go back through the in class / lab exercises, make sure you can work the math / units
- spend a couple days studying, the exam will be essay and there is much material.
- don't wait until the last minute!
- carefully go through the notes, some of the material we briefly discussed, but did not spend much time on in class... but the notes will give you the detail
-finish all your lab exercises before taking the exam!!! Lab questions will appear.
-Exam format: Part 1. Closed book short answer / essay. Part 2. Open-book lab-style problem solving.

Review Selley "Essentials of Petroleum Geology" Text Chapters (posted on Moodle class site);

Chapter 1 Introduction;
"Creekology"
Anticline Theory
Five Conditions of Petroleum Accumulation
- Source
- Reservoir
- Trap and seal
- Timing
- Preservation

Geology and Petroleum
Biology and Petroleum
Exploration vs. Production
Drakes Well, Titusville PA

Chapter 2 Properties;
Hydrocarbon gases
Natural gases
Organic matter
Inert gas
Methane-ethane-propane
Helium
Carbon dioxide
Gas hydrates
Crude Oil
API Gravity
Paraffins-Napthenes-Aromatics-Asphaltines
"Cracking" Distillation
Sweet crude-sour crude

Chapter 4 Subsurface Environment
Subsurface water
Connate-meteoric-juvenile water
Eh – Ph
Concentration
ppt, ppm, ppb
Brine water
Salinity
Total dissolved solids
Subsurface temperatures
Geothermal gradient
Bottom hole temperature
Thermal conductivity
Porosity / compaction
Formation temperatures
Subsurface pressures
Hydrostatic pressure
Lithostatic pressure
Oil-water contact
Pressure gradient
Artesian pressure
Structural pressure

CLASS NOTE REVIEW NEXT PAGES…

Key Words from Notes
(Web links provided below)

Introduction
http://www.wou.edu/las/physci/taylor/es486_petro/1_Introduction.pdf

hydrocarbons
phases: solid-liqud-gas
crude oil
natural gas
kerogen
gas hydrate
tars and resins
sedimentary basin
biogenic sediment
geologic time
thermal maturity
source rock/sediement
reservoir
seals, cap rock
trap
Conditions for Petroleum
    Biogenic sediments
    Source Rock
  Thermogenic Maturation
  Reservoir-Seal-Trap
Dry gas/ wet gas
Sweet vs. sour crude
Inert gases
Light Oil vs. Heavy Oil
Hydrocarbon composition Wt%
  Paraffin
  Napthene
  Aromatics
  Asphaltics
Crude Distillates
Petroleum Engineering
Chemical Engineering
"Cracking"
Exploration-Production-Refining-Marketing
Historical Perspectives on Oil
Drakes Well

Basic Principles Intro to Earth System
http://www.wou.edu/las/physci/taylor/es486_petro/physrevw.pdf

Earth System Science
Environmental Spheres
Atmosphere
Biosphere
Lithosphere
Hydrosphere
Lithosphere-Tectonic Plates
Geothermal-Gravity-Solar
Matter-Energy-Force
Kinetic Energy
Potential Energy
Open System-Closed System
Transfer of Mass
Transfer of Heat
Mass-Energy-Heat Flux
Hydrologic Cycle
Carbon Cycle
Rock Cycle
Tectonic Cycle

Physical Principles
http://www.wou.edu/las/physci/taylor/es486_petro/4A_Physical_Principles_Fluids.pdf

Mass-Length-Time-Temperature
Force-Energy-Work
Motion-Velocity-Acceleration
Acceleration due to Gravity
Pressure
Power
Density
Weight Density = Specific Weight
Viscosity
Heat-solid-liquid-gas
Density-Buoyancy
Temperature-Density Relations
Newtons-Joules-Pascals-Watts
Periodic Chart
Atomic Model
Neutrons-Protons-Electrons
Atomic Number
Atomic Mass
Isotope
Formula Weight
Mole

Review of Sedimentary Rocks
http://www.wou.edu/las/physci/taylor/es486_petro/2_sedimentary_rock_review.pdf

weathering
sediment
sediment transport
sediment burial
lithification
fossil
erosion
lithification
compaction
cementation
Sed. Rock types
    detrital
    biochemical
    chemical
sediment size fractions
    gravel
    sand
    silt
    clay
grain shape
grain sorting
rock types
    sandstone
    conglomerate
    shale
    limestone
    evaporites
crystalline vs. microcrystalline
    coal
clastic / nonclastic
marine
nonmarine
fluvial
lacustrine
glacial
Sedimentary Features
sedimentary structures
methods of transport
bedload
suspension
dissolved load
cross-stratification
graded bedding
reverse grading
normal grading
asymmetric ripples
symmetric ripples
flute casts
cast vs. mold
mudcracks
raindrop imprints
paleocurrents

Overview of Stratigraphy and

Depositional Systems
http://www.wou.edu/las/physci/taylor/es486_petro/3_Overview_Stratigraphy_Depositional_Systems.pdf

Geologic time / Earth History
Age of Earth
Stratigraphy
Stratigraphic Record
Geologic Column / Time
- PreCambrian Era
  - Archeozoic
  - Proterozoic
- Paleozoic Era
  - Cambrian
  - Ordovician
  - Silurian
  - Devonian
  - Mississippian
  - Pennsylvanian
  - Permian
- Mesozoic Era
  - Triassic
  - Jurassic
  - Cretaceous
- Cenozoic Era
  - Tertiary
  - Quaternary

Law of Original Horizontality
Law of Superposition
Law of Uniformitarianism
Law of Cross-Cutting Relations
Law of Faunal Succession
Walthers Law
Relative Geologic Dating
Absolute (numerical) Dating
Half Life
Parent-Daughter Isotopes
Radioactive decay
Horizontal/vertical bed relations
Dike-Sill-Fault
Lithostratigraphy
Biostratigraphy
Seismic Stratigraphy
Index Fossils
Unconformity
Angular Unconformity
Nonconformity
Conformable Strata
Interfingering Strata
Diastem
Lacuna
Paraconformity
Transgression-Regression
Onlap-Offlap
Eustacy
Sedimentary Basins
Facies
Formation
Member
Bed
Marine-NonMarine
Fluvial
Lacustrine
Deltaic
Littoral
Beach-Barrier
Lagoonal-Estuarine
Tidal Flat
Shelf
Slope
Abyssal Plain
Reef

Subsurface Fluids and Conditions
http://www.wou.edu/las/physci/taylor/es486_petro/4_Reservoir_Fluids.pdf
Water-Oil-Gas
Connate-Meteoric-Juvenile
Fluid Density-Buoyancy
Brines
Formation Water
Salinity-Concentration-Total Dissolved Solids
Mass Percent-PPT-PPM-PPB
Solute-solvent
Crude Oil
C-H ratios
Parrafin-Napthene-Aromatics
Asphaltine
Barrels- bbl
Example Parrafin compounds
Example Napthenes-Aromatics
Molecular models
Oil Composition
Density-API Gravity Index
Viscosity-Temperature
Temperature-Volume-Density
Heat Content (BTU, Calorie)
Natural Gas
Dissolved vs. Free
“inflated oil”
Ideal Gas Law

Hydrocarbon Properties
http://www.wou.edu/las/physci/taylor/es486_petro/Hydrocarbon_Properties_Heat_Density_Viscosity.pptx
Heat-Energy
Calorie
Joule
BTU
Thermal heat value
Density-specific gravity
API gravity index
Viscosity
Volume – bbl = barrel = 42 gal

Subsurface Temperature and Pressure
http://www.wou.edu/las/physci/taylor/es486_petro/4B_Subsurface Temperature and Pressure.pdf
Heat-Energy
Heat flux
Heat flow
Geothermal gradients
Thermal conductivity
Pressure
Overburden pressure
Lithostatic pressure
Hydrostatic pressure
Pressure gradients
Formation temperature
Formation pressure
Bottom hole temperature
Bottom hole pressure
Thermal maturation

Quantitative / Lab Skills

Quantitative Methods
Perform basic unit conversions-unit algebra-solve quantitative word problems
Process Rate Calculations
calculate potential energy, kinetic energy, force, weight, stress
pressure-depth calculations
application of idea gas law to subsurface gas accumulations
calculation of basic engineering properties of rocks
porosity-density-specific weight
Sedimentary Rocks
what about the three diff. types of sed. rocks?
Can you estimate: grainsize? sorting? grading? angularity?
What about basic paleocurrent directions? How can you tell which way the fluid was moving when the sediment was deposited?
What about recognizing some basic sedimentary structures?
Associating a specific rock type to a possible sedimentary environment?
How does transport energy relate to grain size of deposits? (e.g. would you find boulders in the deep ocean?)
What are the basic marine and nonmarine sedimentary environments?
What are sedimentary structures and how are they used to reconstruct sedimentary environments?
What type of environment do the various sed. rock types form? e.g. sandstone, conglomerate, evaporites, coal, mudcracks, limestone, etc. where would these rocks form at the earth's surface?
Review the lab answer keys on class web site!

Big Concepts for Long-Answer Essay Questions
What are the primary types of hydrocarbons?
What are the criteria necessary for the generation and accumulation of hydrocarbons in subsurface?
What compounds are petroleum and natural gas composed of? What are the basic carbon families and their general molecular compositions? What is the process necessary to find and produce petroleum-related products for industry? What is the basic refining process? How does transport energy relate to grain size of deposits? (e.g. would you find boulders in the deep ocean?) What are the fundamental energy sources of the earth system How do force-energy-pressure relate to the subsurface environment? What are the temperature and pressure conditions like in the subsurface environment?
What are the fundamental components of the Earth System?
How do the study of sedimentology and stratigraphy relate to petroleum geology?
What are the basic laws and principles of stratigraphy used to analyze sedimentary rocks?
What are the basic marine and nonmarine sedimentary environments?
What are sedimentary structures and how are they used to reconstruct sedimentary environments?
What type of environment do the various sed. rock types form? e.g. sandstone, conglomerate, evaporites, coal, mudcracks, limestone, etc. where would these rocks form at the earth's surface?
How do sediments accumulate over time? How is time recorded in the rock record?
What are the primary fluids contained in the subsurface environment? Relative abundance and composition of each? What is the chemical composition of formation water? Crude oil? Natural gas?
What are the key properties used to characterize petroleum and natural gas?
How is petroleum generated? What are the geologic conditions necessary? Discuss the global carbon cycle in the context of petroleum geology. What are the sources of organic materials in petroleum? Chemical composition? What are the steps in petroleum generation? The thermal maturation process?