ES476/576 Hydrology Final Study Guide Winter 2010

Exam Format: *Similar to Mid-Term.*

Part 1 - Lecture Exam: closed book exam, short answer, essay, terms, definitions (make sure you know how to sketch relationships).

Part 2 - Lab Exam: Equation lists, conversion charts, and calculators accessible (but not entire note books). Suggestion, organize diagrams and equation lists by topic, so that you can easily find and use your tools on the open-book portion of the exam.

Key Terms and Concepts

Intro to Groundwater

Physics Review (know units and be able to calculate / define the following):
- potential energy
- kinetic energy
- force
- work
- weight
- density
- specific weight
- pressure

Groundwater
- defined
- meteoric
- connate
- juvenile

porosity
- intergranular
- primary
- secondary
- fracture
- vesicular

effective porosity
- hygroscope water
- pendular water

porosity vs. lithology / material
specific yield
specific retention
hydraulic conductivity
- permeability
- Darcy's Law

diagram darcy's law
hydraulic gradient
vertical conductivity
lateral conductivity
permeability vs. lithology / material
pH - defined, calculated
aquifers
recharge
vadose zone
phreatic zone
water table
groundwater flow
cone of depression
drawdown
unconfined aquifer
confined aquifer
aquitard
aquiclude
capillary zone
atmospheric pressure
potentiometric surface
hydraulic contours
groundwater flow directions
- upgradient
- downgradient

transmissivity
storativity
specific storage
isotropic vs. anisotropic
Groundwater issues
- water resource
- water budget
- contamination
- pumping / recharge

Wells
- pumping well
- injection well
- static water level
- cone of depression

permeameter
Darcy's Experiment
water table
potentiometric surface
confined
unconfined
artesian
free-flowing artesian
groundwater map
hydraulic gradient
aquiclude
aquitard
leaky confined aquifer
static water level
depth to water
water table elevation
upgradient
downgradient
groundwater flow vectors
fractured aquifer
porous medium
aquifer skeleton

Groundwater Flow

Advection
Retardation
hydrostatic pressure
atmospheric pressure
kinetic energy
potential energy
fluid pressure
total energy equation
hydraulic head
piezometer
hydraulic gradient
groundwater flow vectors
Darcy's Law
Darcy's Flux
Seepage Velocity (linear

velocity)
groundwater flow net
equipotential lines

hydraulic gradient
transmissivity
storativity
hydraulic conductivity
pumping rate
partial penetration

groundwater flow line

Field Trip / Drilling Techniques

Hollow stem auger
Cable tool drilling
Air rotary drilling
"Casing"
"Well Screen"
Split spoon
Blow counts
Shelby tube
Grout
Slotted screen
Riser pipe
Sand pack
Tri-cone rotary bit
Well log
Drillers log

Well Hydraulics

Total depth
Bore-hole diameter
Annular diameter
SWL
TD
Static water level
DTW
Depth to water
Datum

know what a well installation looks like (be able to sketch it)

drill rig
hollow stem auger
well screen
well riser
well diameter
static water level
pumping water level
well recovery
drawdown
residual drawdown
cone of depression
saturated thickness

Lab Skills to Focus On for Final

Can you perform simple and complex unit conversions?

Do you understand dimensional analysis and unit algebra?

Do you know how to manage positive and negative exponents with respect to unit algebra?

Can you perform the following quantitative skills from the first lab:
- plotting a graph
- re-arranging equations
- solving for unknown variables in an equation
- manipulating exponents and bases
- convert between metric and english systems of measurement

Can you perform the following quantitative skills from the second lab:
- determine volumes of water in a reservoir
- calculating rates of discharge, evaporation and input into a hydrologic system
- converting between various measures of area, length, volume, and discharge
- determine the total input and withdrawl from a simple hydrologic system (calcuating water budgets)

Can you perform the following quantitative skills from the contouring exercises
- draw contour lines on rainfall data? draw contour lines on groundwater elevation data?
- identify contour intervals and interpolate between data points

Can you perform the following quantitative skills from the intro groundwater problem set (set 1)?
- calculate: weight, force, density, specific weight as applied to water
- solve for the variables in Darcy's law
- determine hydraulic conductivity from a set of given values
-calculate transmissivity of an aquifer
-draw a groundwater contour map and draw generalized groundwater flow lines
- Can you calculate hydraulic gradient from a groundwater contour map

How about the problems from Groundwater problem set two.
Check out the answer keys and make sure you can work the problems and tutorials for the following labs:

- Groundwater Problem Set 1 (Introduction to Groundwater)
- Groundwater Problem Set 2 (Groundwater Flow)
- Digital Mapping / Surfer Exercises
- Introduction to Surfer Tutorial Exercise
- Applications of Surfer to Groundwater Hydraulics
- Well Hydraulics / Aquifer Testing Exercise

Other Stuff I've Thought of...
how is the saturated thickness of the aquifer affected by pumping in a confined vs. unconfined aquifer?

What is the difference between a confined and unconfined aquifer, how do you know which is which in the

groundwater environment?

Can you sketch a scenario if given well geometry and aquifer configuration?
Short answer / essay on hydrogeologic field techniques:

1. List the 5 objectives of proper well design.
2. List the 5 types of hydrogeologic information that is required for the proper design of wells.
3. What are the two main elements of a “well”?
4. Why is the diameter of the well casing important when designing a well?
5. List three reasons why a well should be completed to the bottom of an aquifer.
6. What types of field data are used to determine the best aquifer producing zones in the subsurface?
7. List the 4 type of aquifer conditions or “hydrogeological situations” that are typically encountered, and/or should be considered when installing a well.
8. Describe the process of rotary drilling and the aspects of this technique that result in a “clean hole” that is well-ready.
9. List the 6 functions of drilling fluids.
10. What is the difference between air-rotary and mud-rotary drilling?
11. What is a “tremmie pipe” and how is it used to install a well?
12. Why are the type of sand pack and screen opening widths important when designing a well?

Key Groundwater Equation Summary (problem focus for exam):

Work
Force
Weight
Pressure
Density
Porosity
Permeability
Specific Yield
Specific Retention
Darcy’s Law / Permeameter Equations
Transmissivity
Storativity
Hydraulic Gradient
Darcy’s Flux (Q)
Seepage Velocity
Well Drawdown
Well Yield
Well Specific Capacity