ES302 Quantitative Methods Spring 2021 Midterm Exam Study Guide

The Midterm Exam will be available on Friday May 7 between 8 AM and 11 PM, with a 3-hour time limit once the exam is opened. The exam format will be a combination of short-answer terminology and lab-style quantitative problems. Labs have largely focused on the basics of unit conversion, applied algebraic problem solving, and map work (scaling, location, direction, elevation, contouring, digital elevation models). Be prepared to make sketches of diagrams and recall key equations to illustrate your answers.

I would spend a minimum of studying 8-10 hours total for this exam, to assure maximum success. Use the keyword and concept list below as a check list for studying.

Class Notes and Readings to Review:

Introductory Math and Algebra Review https://people.wou.edu/~taylors/g302/mathrev.pdf
Guidelines for Problem Solving https://people.wou.edu/~taylors/g302/steps_in_problem_solving.pdf
Intro Dimensional Analysis https://people.wou.edu/~taylors/g302/units_conversion_rules_schoenfeld.pdf
Waltham Chapter 1 Solving Geologic Problems https://people.wou.edu/~taylors/g302/waltham1.pdf
Intro to Geologic Thinking https://people.wou.edu/~taylors/g302/AGI_Lab_Manual_Intro_Methods.pdf
Notes: Review of Maps / Topographic Maps https://people.wou.edu/~taylors/g302/maps.pdf
Reading: Topo Maps https://people.wou.edu/~taylors/g302/9_AGI_lab_manual_lab9_Topo_Maps.pdf
Waltham Ch. 2 Geologic Variables https://people.wou.edu/~taylors/g302/waltham2.pdf
Waltham Ch. 3 Equation Manipulation https://people.wou.edu/~taylors/g302/waltham_chap3.pdf
Contouring Techniques https://people.wou.edu/~taylors/g302/Contouring_Techniques.pdf
Digital Elevation Models https://people.wou.edu/~taylors/g302/Intro_DEM.pdf

Supporting Video Study Tutorials:

Solving Physics Problems https://www.youtube.com/watch?v=YocWuzi4JhY
Unit Conversions https://www.youtube.com/watch?v=HRe1mire4Gc
Intro Topo Maps https://www.youtube.com/watch?v=zqPMYGDxCr0
Topographic Profiles https://www.youtube.com/watch?v=StDYPIuk25M
Map Scales https://www.youtube.com/watch?v=co0CXao7IuY
Bearings and Azimuth https://www.youtube.com/watch?v=lM6kWrgsGYw
Longitude and Latitude https://www.youtube.com/watch?v=swKBi6hHHMA
Universal Transverse Mercator https://www.youtube.com/watch?v=LcVlx4Gur7I
Re-Arranging Equations https://www.youtube.com/watch?v=eTSVTTg_QZ4
Solving for Unknowns https://www.youtube.com/watch?v=BpLHHTY_umM
Rates and Slopes of Lines https://www.youtube.com/watch?v=Iqws-qzyZwc
Sedimentation Rates https://www.youtube.com/watch?v=9ch-6HiOAW4
Drawing Contour Lines https://www.youtube.com/watch?v=L6FbV0LiA_k
Image Resolution https://www.youtube.com/watch?v=jp2Q2g0A5wc
Intro to DEMs https://www.youtube.com/watch?v=pnAdasqHxGk

Key Words from Notes, Video Exercises and Readings

Introductory Math and Algebra Review
https://people.wou.edu/~taylors/g302/mathrev.pdf
decimal system
decimal fractions
scientific notation
powers of 10
metric vs. English system
metric prefixes
- Peta
- Tera
- Giga
- Mega
- Kilo
- Hecto
- Deka
- Deci
- Centi
- Milli
- Micro
- Nanno
- Pica

Length: Meters
Area: Acre, Hectare
Volume: m^3, cm^3 ft^3 gallons
Mass: gram, kg, tonne
Temerature: oF oC
Dimensional Analysis:
- Distance
- Mass
- Time
- Area
- Volume
- Velocity
- Acceleration
- Force
- Energy

Empirical equations
Significant figures
Unit algebra
Unit cancellation
Rules of exponents
Graphic visualization
Line Slope
Equation of Line
Y intersect

Guidelines for Problem Solving
https://people.wou.edu/~taylors/g302/steps_in_problem_solving.pdf
Six Steps:
1. Read
2. ID variables
3. Draw and sketch
4. Convert units
5. Rearrange, solve
6. Check your answer

Intro Dimensional Analysis
https://people.wou.edu/~taylors/g302/units_conversion_rules_schoenfeld.pdf
System International SI Units
Metric measure
Length, mass, time
Velocity, acceleration, area, density
Dimensional analysis: unit balancing and cancellation
Powers of 10
Orders of magnitude

Waltham Chapter 1 Solving Geologic Problems
https://people.wou.edu/~taylors/g302/waltham1.pdf
qualitative vs. quantitative problem solving
sedimentation rate
constants vs. variables
proportions and ratios
Geologic Age-Depth Relations
Greek symbology
Δ = "delta" change in variable over time
Superscripts, subscripts
Exponents
Scientific notation
Powers of 10
Orders of magnitude
Metric SI system of measurement
Decimal fractions
Unit conversion

Intro to Geologic Thinking
https://people.wou.edu/~taylors/g302/AGI_Lab_Manual_Intro_Methods.pdf
Geologic Record
Geologic Time
Scaling
Spatial Scales
Bar scale
Fractional scale
Ratio Scale
Graphical scale
Global-Regional-Local Scale
Microscopic Scale
Megascopic Scale
Macroscopic Scale
Geologic Time Scale
Hypothesis Testing
Scientific Method
Multiple Working Hypothesis
Geosphere
Hydrosphere
Biosphere
Atmosphere
Magnetosphere
Heat Energy
EM Energy
Potential Energy (gravity)
Kinetic Energy
Mechanical Energy
Chemical Energy
Electrical Energy
Energy vs. Force
Cycles of Time and Mass
Orders of magnitude
Scientific notation
SI Measurement System
Linear Measurement
Area-Volume
Mass
Time vs. Rates
Unit Conversion
Density
Graphs
- Line X-Y
- Bar Graph
- Scatter Graph

Gravity-Density-Isostasy

Topography
Hypsometric Curve

Review of Topographic Maps
https://people.wou.edu/~taylors/g302/maps.pdf
topographic maps
north arrow
magnetic declination
map scale
fractional scale
graphical scale
longitude, latitude
degrees-minutes-seconds
township-range-section
equator
prime meridian
parallels
angular measurement
7.5 min quadrangle
contour interval
index contour
law of V's / streams
air photos
stereovision
map projection
DEM, Grid

Overview of Topo Maps
https://people.wou.edu/~taylors/g302/9_AGI_lab_manual_lab9_Topo_Maps.pdf
Map
Topographic map
Quandrangle map
7.5-minute quadrangles
Latitude-longitude
Degrees-minutes-seconds
Map scale
Ratio vs. graphical scales
Verbal scale
Compass bearings
Magnetic declination
Azimuth vs. Quadrant Bearing
UTM Location System
Township-Range System
Map symbols
North arrow
Map title
GPS, Global Positioning
Triangulation
Public Land Survey System
Aerial Photographs
Stereograms
Orthoimages
Contour lines
Index Contour
Contour Interval
Elevation
Depressions
Ridges and valleys
Spot elevations
Benchmarks (BM)
Rules for Contouring
Relief and Gradient
Topographic profile

Waltham Ch. 2 Geologic Variables
https://people.wou.edu/~taylors/g302/waltham2.pdf

geologic rates and functions
linear relationships
equation of a line
$Y = mX + B$
Y-intercept
Slope of line (rise / run)
Equation variables
ΔX and ΔY
Quadratic Equation
Polynomial Functions
Exponents and powers
Positive vs. negative powers
Fractional powers
Square root
Exponential functions
Logarithmic functions
Logarithms
Uses of Log Functions
1. Rearrange exponential equations
2. Reduce exponential functions to straight lines
3. Compress and transform large data set

Log base 10
Log base 2

Waltham Ch. 3 Equation Manipulation
https://people.wou.edu/~taylors/g302/waltham_chap3.pdf
equation manipulation
solving for unknown variables
combining and simplifying equations
cancelling variables
variable substitutions
order of operations: brackets and braces
factorial vs. distributive property
rearranging equations

Contouring Techniques
https://people.wou.edu/~taylors/g302/Contouring_Techniques.pdf
contour lines
isopach lines
isochre lines
isobar lines
isotherm lines
isolith lines
structure contour lines
3-D visualization
Subsurface mapping
Dipping surfaces
Rules of contour lines
1. Cannot cross
2. Can merge
3. Cannot split
4. Can close
5. Can end at edge of map

Elevation Datum = sea level
Contour interval
Index contour
Map scale
Hachured lines
Control Points
Parallel contour patterns
Mechanical vs. digital contouring
Interpretive contouring
Computer modeling
Gridding
Triangulation
Delaunay triangles

Nearest neighbor analysis
Grid nodes
Estimated fit
Triangulation
Surface stacking

Digital Elevation Models
https://people.wou.edu/~taylors/g302/Intro_DEM.pdf
Terrain Modeling
Digital Elevation Model DEM
Digital Terrain Model DTM
Grid pattnerns
Data capture
Visualization
Grid resolution
Elevation point data
Contour maps
Remote Sensing
DEM Interpolation
Triangulation TIN
Data filtering, processing
Sinks and Pits
Shaded relief map
Slope map
Aspect map
Profile curvature
Elevation and vertical precision

Possible short answer essay questions and problem solving concepts

- What is the difference between a dimensionally balanced analytical equation and an empirical equation?
- What is the difference between the SI system of measurement and English system
- What is unit algebra, and how is it used to solving equations?
- What are the basic concepts of physical measurement in nature: length, mass, time, temperature, area, volume, density, velocity, acceleration, force, energy
- What is a DEM, how is it created.

Map reading, photo observation.
Can you conduct basic calculations of map scale, and unit conversions?
Can you draw a profile and make basic map observations? Can you read a topographic map?
Can you solve basic hydrology / watershed problems? Calculate slope and gradient.
Determine the equation for a line
Determine elevations from a map
Measure locations in Lat-Long and UTM
Measure bearings in the azimuth and quadrant systems
Can you draw contour lines from point data?
How do powers of 10 work in the metric system?
Can you draw a topographic profile?
Can you re-arrange an equation and solve for the unknown?
Can you read a problem and draw a sketch showing a visual representation?
Can you determine the scale of a map? Use a map scale to make measurements?

The exam will also include an open-book problem solving portion related to the lab exercises; review lab answer keys posted on class web site: https://people.wou.edu/~taylors/g302/ES302_home.html