ES322 Geomorphology Fall 2023
Final Exam Study Guide

Final Exam is on Tuesday Dec. 5, 2023 starting 12 noon in NS218; unlimited time for completion, but 3 hour availability window is recommended. Please let the professor know if you need an early start time. Lunch will be provided.

Part I Exam – Closed Book Essay / Short Answer; Part II Exam – Open Book Problem Solving (based on lab practice questions and landform analysis / review worksheet)

Final Exam Topics: Week 5 – Drainage Basins/Rivers Follow Up; Week 6 Glacial, Week 7 Deserts / Wind, Week 8 Tectonic, Week 9-10 Quaternary Climate Change

Study Tips

- complete all labs and worksheets before exam; complete and review the textbook questions, some of them will be on the exam verbatim.
- use study guide in combination with notes and online powerpoint slide shows; important focus concepts are highlighted in yellow
- go back through the in class / lab exercises, make sure you can work the math / units; review map skills
- spend a couple days studying, the exam will be short answer / essay and there is much material.
- don't wait until the last minute!
- carefully go through the notes and review questions from homework assignments.

Exam Procedures

(1) Final exam will be 115 points.
(2) Part 1 – Closed book, short answer/essay questions, focusing mainly on material since mid-term, but we have been building a cumulative vocabulary throughout the term. See key-word/review recommendations below. ; important focus concepts are highlighted in yellow
(3) Part 2 Open Book- lab-style quantitative questions based on in-class practice problems, map questions, identification of fluvial, glacial landforms, identification of basic climatic / tectonic / geomorphic features; association of landforms with processes, association of landform photos with processes and concepts.

LAB SKILLS / CONCEPTS

Topographic Maps; landform identification; stream gradient calculation; hillslope gradient calculation; elevation / relief; watershed morphometry calculations: drainage area, ~~drainage density~~, stream ordering, ~~basin ruggeness, basin relief~~; landform identification; climate interpretation; map scale determination; glacial ~~budget exercise: ice mass vs. volume calculations, time series graphs, graphing, Coast Neotectonics:~~ calculate uplift rates and erosion rates from raw data.

-be able to interpret relationships between tectonic uplift and global sea level change, can you identify which process is affecting a given sea level record

-how has global sea level changed during the late Quaternary, and why?; make sure you can calculate slopes and gradients from topographic maps

- ~~make sure you understand all of the concepts associated with the coastal geomorph. lab, as they apply to the pacific northwest;~~ Process Rate Calculations; Basic map reading / landform identification from a topographic map and text + powerpoint photos.

KEY WORDS FROM CLASS NOTES AND TEXTBOOK:

Textbook Review Questions: Chapter 7 Drainage Basins
https://people.wou.edu/~taylors/g322/Bierman_Montgomery_Chap7_Drainage_Basins_Review_Questions.doc

watershed + drainage basin
channel network
perennial vs. ephemeral streams
drainage divide (interfluve)
headwaters vs. basin outlet
open basin vs. closed basin
tributary network
sediment source vs. sink
sediment discharge vs. water discharge
sediment routing
hillslope storage
valley bottom storage
tributary junctions
drainage patterns
- rectangular
- dendritic
- trellis
- radial

Colluvial vs. alluvial process
Hillslope vs. valley process
Bedrock vs. alluvial valleys
Knickpoints
terraces
Longitudinal profiles
Transverse profiles
Basin Sediment Storage
- Floodplains + terraces
- Alluvial fans
- Colluvial (debris) fans

Class Notes: Glacial Processes and Landforms
https://people.wou.edu/~taylors/g322/glacial.pdf

Glacier
Snowfield
Snow-firn-ice
Ice stratification/accumulation
Ice deformation
- Plastic vs. brittle

Plastic = internal flow
Brittle = crevasses/fracture
Ice Flow Mechanisms
- Basal sliding
- Internal deformation
- Plastic deformation
- Crevassing

~~Glacial surging~~
Glacial meltwater
Ice-water mixture
Glaciers as aquifers
Temperate glaciers = wet
Polar glaciers = dry
Alpine vs. Continental glaciers
Glacial advance
Glacial retreat
Ablation/melting
Zone of accumulation
Zone of ablation
Glacial erosion
- Plucking
- Abrasion
- Subglacial water flow

Glacial Deposits
- Drift
- Till
- Outwash
- Erratics
- Diamicton

Alpine Erosional Landforms
- Cirque
- Tarn
- Arete
- Cols/Horn
- U-shape valley
- Hanging valley
- Fjords
- Roche Moutonee
- Striated pavement

Alpine Depositional Landforms
- Moraine
- End Moraine
- Lateral Moraine
- Medial moraine
- Terminal moraine

Continental Landforms
- Drumlin
- Esker
- Kame
- Kettle
- Outwash Plain

Textbook Review Questions – Chapter 9 Glaciers
https://people.wou.edu/~taylors/g322/Bierman_Montgomery_Chap9_Glacial_Review_Questions.doc

Glaciers
Permafrost
Alpine glacier
Cirque glacier
Piedmont glacier
Continental glacier
Ice sheets
Ice cap
Pleistocene
Last Glacial Maximum
Laurentide Ice Sheet
Cordilleran Ice Sheet
Glacial Mass Balance
Glacial advance
Glacial retreat
Ice accumulation
Ice Ablation
Meltwater
Firn-snow-ice
Equilibrium line altitude
Ice creep
Internal flow / deformation
Basal sliding
~~Viscoplastic solid~~
~~Brittle deformation~~
~~Ductile deformation~~
~~Glacial calving~~
Ice margin
Ice shelf
Marine ice
Plucking / quarrying
Warm vs. cold glaciers
Temperate vs. polar glaciers
~~Moulon~~
~~Jokulhlaups~~
~~Meltwater lake~~
Striation-polish-rock flour
Glacial buzzsaw
Diamicton
Till
Melt-out till
Ice-contact till
Kettle
Kame
Crevasse

Esker
Outwash plain
Varves
Dropstones
Rhythmites
Ice rafted debris
Moraine
Terminal moraine
End moraine
Lateral moraine
Recessional moraine
Arete-horn-cirque
Tarn – paternoster lake
Pro-glacial lake
Drumlin-esker
~~Nunataks~~
Periglacial
Paraglacial
Permafrost
Patterned ground

Class Notes: Deserts / Arid Geomorphology
https://people.wou.edu/~taylors/g322/deserts.pdf
arid / semi-arid defined
precipitation levels
Causes of Deserts
- High pressure
- Orographic
- Latitude
- Cold ocean currents

Sub-tropical deserts
Polar deserts
Rainshadow deserts
Wind vs. Fluvial processes
Desert Landforms
- Alluvial fans
- Fault-block mountains
- Mesa
- Butte
- Playa
- Dune vs Ergs
- Bajada
- Pediment
- Inselberg

Wind Processes (Aeolian)
- Deflation
- Saltation
- Suspension

Dune Types
- Transverse
- Longitudinal
- Parabolic
- Barchan

Loess
Desert pavement
Desert varnish
Ventifact

Textbook Review Questions – Chapter 10 Deserts + Wind
https://people.wou.edu/~taylors/g322/Bierman_Montgomery_Chap10_Wind_Review_Questions.doc
~~Aeolian / wind~~
~~Wind velocity~~
~~Air pressure~~
~~Stokes equation~~
Katabatic winds
Wind throw
Saltation
Ventifact
Loess
Yardang
Blow out
Deflation
Desert pavement
Erg
Transverse dune
Linear dune
Star dune
Parabolic dune
Barchan dune
Desert varnish

Class Notes: Tectonic Geomorphology
https://people.wou.edu/~taylors/g322/tectonic.pdf
convergent boundary
divergent boundary
transform boundary
mountain front
brittle vs. ductile deformation
anticline
syncline
mountain building
normal fault
reverse fault
strike slip fault

~~plunging fold~~
~~non-plunging fold~~
~~joints~~
~~dip~~
~~strike~~
~~dip-slope~~
~~scarp-slope~~
~~anti-dip slope~~
~~lithologic resistance to erosion~~
~~sandstone-shale example~~
~~differential erosion~~
hog back / cuesta
resistant bedrock
non-resistant bedrock
~~law of v-shape patterns~~
~~joint-fault erosion~~
~~lineaments~~
fault scarp
butte / mesa
cap rock
fault scarp degradation
zig-zag mountains
differential erosion

Textbook Review Questions – Chapter 12 Tectonic Geomorphology

https://people.wou.edu/~taylors/g322/Bierman_Montgomery_Chap12_Tectonic_Geomorphology_Review_Questions.doc

Active tectonics
Neotectonics
Active deformation
Plate tectonics
Convergence/subduction
Divergence/spreading
Transform
Crustal uplift / subsidence
Rifting
Rock uplift
Surface uplift
Exhumation
~~Isostatic rebound~~
~~Lithospheric flexure~~
~~Forebulge~~
~~Flexural upwarping~~
~~Flexural downwarping~~
~~Foreland basin~~
~~Forearc basin~~

Fault-bounded basin
Diapir
Brittle / ductile deform
Fault
Fault scarp
Reverse fault
Normal fault
Transverse fault
Rift zone
Pull-apart basin
Active margin
Passive margin
Horst/graben
Orogen
Thrust fault
Blind thrust
Transform margin
Transtensional margin
Transpressional margin
Restraining bend
Releasing bend
Offset stream
Shutter ridge
Sag pond
Craton
Shield
Plateau
Inselberg
Monadnock
Anticline / syncline
Anticlinal valley
Synclinal valley
monocline
Hog back
Cuesta
Flatiron
Triangular facet
Mesa / butte
Joints
Fractures
Lineaments
Coastal uplift
Marine terrace
Strath terrace

Class Notes: Coastal Geomorphology
https://people.wou.edu/~taylors/g322/coasts.pdf
coast
beach
tectonics
waves
tides
tsunami
storm surge
longshore drift
rip current
tides
gravity
pocket beach
marine terrace
wave-cut notch
wave-cut terrace
emergent coasts
submergent coasts
erosional coasts
depositional coasts
headlands
sea cliff
sea stacks
sea arches
wave-cut platform
uplifted coasts
sea level change
global sea level rise /fall
global climate cycles
interglacial / glacial
PNW tectonic setting
convergent
subductions
neotectonic uplift
relative sea level change
uplift vs. SL change
subsidence vs. SL change
global warming
density currents
thermal expansion of water
re-leveling surveys
tide-gage surveys
tectonic vs. sea level changes
seasonal wave activity in OR
winter vs. summer beaches
rocky headlands
pocket beaches
littoral cell
heavy mineral / provenance
estuaries

Textbook Review Questions –

Chapter 8 Coasts
https://people.wou.edu/~taylors/g322/Bierman-Montgomery_Chap8_Coastal_Geomorphology-Review_Questions.docx
Continental Margins
Continental shelf
Continental slope
Continental rise
Abyssal plain
Tectonic trench
Mid-oceanic ridge
Estuary
Active vs. Passive Margin
Emergent vs. Submergent Coasts
Global Sea Level Change
Tectonic vs. Eustatic Sea Level Change
Transgression vs. regression
Glacial vs. interglacial climate
Low sea level stand vs. high sea level stand
Tides – gravity driven
High tide vs. low tide
Spring tide vs. neap tide
Tidal bulge
Diurnal tidal cycle
Waves- wind driven
Wavelength-amplitude
Wave velocity
Wave base
Breakers, swash zone
Beach zone
Longshore current
Rocky headland
Bays and coves
Pocket beach
Storm surge
Tsunami
Wave-cut notch
Wave-cut platform
Sea cliffs
Marine terrace
Sea stack, sea arch
Spits
Delta
Gilbert-style delta
Barrier island
Tidal rivers
Tide flats
Coastal plains

~~Estuary vs. fjord~~

~~*Journal Reading / Review Questions: Kelsey and others 1996, Quaternary Deformation of Coastal Oregon*~~
~~http://www.wou.edu/las/physci/taylor/g322/Kelsey_etal_1996.pdf~~

~~Draw a sketch and discuss how wave-cut platforms and marine terraces developed on the Oregon Coast during the Quaternary.~~

~~Describe the plate tectonic setting of western Oregon and how it influences the landforms at the Earth's surface we see today.~~

~~How are marine terraces and soil development indices used to determine uplift rates on the Oregon Coast. Provide examples of results discussed in the journal article.~~

Class Notes: Quaternary Climate Change
http://www.wou.edu/las/physci/taylor/g322/quaternary_climate_change.pdf

Pleistocene Ice Ages
Glacial/Interglacial Climates
Solar-Geothermal Exchange
Global climate change
~~Greenhouse effect~~
~~Greenhouse gases~~
~~Carbon Cycle~~
Quaternary Sea Level Curve
Evidence of Past Glaciation
- Continental Landforms
- Continental Deposits
- Marine Record
- Oxygen Isotopes
- Fossil Evidence
- Paleoclimatology

Laurentide Ice Sheet
Cordilleran Ice Sheet
Sea-Level Fluctuation
Global Sea Level Change
Pluvial Lakes
Great Lakes
Missoula Floods
Ice Cores
Glacial maximum
Oxygen isotope stages
Ice-Ocean Isotope Exchange
Ocean cores
Ice cores
100,000-43,000-20,000
Stable Isotope Analysis
Oxygen18/Oxygen16
Global ice budget
Global ocean budget
~~isotopic fractionation~~
~~"heavy water"~~
~~"light water"~~
glacial climate
interglacial climate
ice sheet
evaporation
late Wisconsinan ice
global sea level
eustatic sea level
deep sea drilling
O18 stratigraphy
O18/O16 ratio
global correlation
radiometric dating
orbital forcing
general circulation model
Milankovitch Theory
- obliquity
- eccentricity
- precession

angle of earth tilt
orbital path
plane of ecliptic
~~Global Warming~~

Textbook Review Questions – Chapter 13 Climate Change
https://people.wou.edu/~taylors/g322/Bierman_Montgomery_Chap13_Climate_Change_Review_Questions.docx
Global climate change
Carbon cycle
Carbon dioxide emission
Carbon sequestration
Greenhouse effect
LGM – last glacial maximum
Relict landform
Holocene/Pleistocene
Glacial / interglacial
Pluvial environment
Glacial advance /retreat
Lake / marine sediment
Varves
IRD ice rafted debris
Pollen
Macrofossils
Packrat middens
Foraminifera
Oxygen isotope ratio
O^{18}/O^{16} isotopes
H_2O^{16} vs. H_2O^{18}
Marine isotope stage
Paleothermometry
Ice cores
Gas / fluid inclusions
Loess
Paleosol
Climate cycle
Glacial cycle
Isotopic excursion
Terminations
Orbital forcing
Solar radiation
Celestial mechanics
Eccentricity
Obliquity
Precession
Milankovitch cycle
Thermohaline circulation
Gulf Stream
North Atlantic Conveyor
Younger Dryas
Heinrich Events
IRD
Altithermal / midHolocene
Little Ice Age
High Sea Level Stand
Low Sea Level Stand