ES322 Geomorphology Fall 2020
Final Exam Study Guide

NOTE:
Online Take-Home Final Exam Distributed on Thursday Dec. 10, 2020; availability window 8 AM-11 PM via Moodle, 3 hour completion window once the exam is started. Leave plenty of time before 11 PM due time to allow for completion.

Part I Exam – Closed Book Essay / Short Answer; Part II Exam – Open Book Problem Solving

Final Exam Topics: Week 5 Drainage Basins, Week 6 Glacial, Week 7 Deserts, Week 8 Tectonic, Week 9 Coasts, Week 10 Quaternary Climate

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, some of the material we briefly discussed, but did not spend much time on in class... but the notes will give you the detail.

Exam Procedures

(1) Final exam will be 125 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, map questions, air photo 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. Bring a calculator.

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; ~~topographic profiles; scale / vertical exaggeration; Air Photo Interpretation; 3-D stereo view~~; landform identification; climate interpretation; scale determination; ~~Fluvial Lab; work key equations: mannings, continuity, stream power, discharge unit conversions, determine stream gradient, channel profiles, river discharge measurements, calculate air photo metrics~~, glacial budget exercise: ice mass vs. volume calculations, time series graphs, graphing, alluvial fan morphometry: fan area, fan relief, drainage basin area, graphing functions; Coast Neotectonics: calculate uplift rates and erosion rates from raw data.

~~-be able to identify fold and fold features from topographic maps~~
~~-understand the relationships from the "fluvial balance" model of aggradation and degradation~~

-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

~~-can you plot a ternary diagram using soil texture data?~~
~~-can you determine the recurrence interval of a given flood discharge?~~
~~- how about solving hydraulic flow problems using Manning's Equation and the Continuity Equation?~~
~~-what is the relationship between river load, type of sediment, and river morphology?~~
~~-can you identify landforms / geologic processes from air photos?~~
~~-how about identifying other landforms: e.g. point bar, cut bank, alluvial fans, deltas, lava flows, volcanoes?~~

- 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.

~~Given a rate of weathering and "soil erosion", calculate the equivlalent rate of crustal denudation and rock erosion~~
~~From a topographic map, caculate hillslope gradient (in degrees, in percent, in ratio form)~~
~~Draw a topographic profile from a topographic map.~~
~~determine slope stability; calculate gradient and slope angle in degrees and percent~~

~~identification of basic landforms and geomorphic process by examining aerial imagery~~

~~calculating the slope of stream channel or hillslope from a topographic map (in degrees and percent)~~

KEY WORDS FROM CLASS NOTES AND TEXTBOOK:

Class Notes: Drainage Basins & Watersheds
https://people.wou.edu/~taylors/g322/class_notes_drainage_basins.pdf
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 budget
sediment flux / transport
sediment storage
mass flux storage equation
input-output = change in storage
sediment source vs. sink
sediment discharge vs.
water discharge
sediment routing
hillslope storage
valley bottom storage
tributary junctions
drainage patterns
  rectangular
  dendritic
  trellis
  radial
stream ordering
shreve magnitude
first-order streams
Hortons laws
Strahler stream ordering
Discharge-order relations
Colluvial vs. alluvial process
Hillslope vs. valley process
Bedrock vs. alluvial valleys
Knickpoints
terraces
Longitudinal profiles
Transverse profiles
Basin Morphometry
Basin relief
Drainage density
Basin ruggedness
Basin Sediment Storage
  Floodplains + terraces
  Alluvial fans
  Colluvial (debris) fans
  Lakes

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 rudge
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