GIS in Water Resources Review for Midterm Exam Fall 2017

The material is classified according to Bloom's Taxonomy of Educational Objectives:

Level	Title	Meaning
1	Knowledge	Definitions, facts, formulas
2	Comprehension	Explanation of definitions, formulas, problem solving procedures
3	Application	Know how to use a formula or procedure to solve simple problems
4	Analysis	Break down a complex problem and solve by steps
5	Synthesis	Derivation of basic formulas, design of new systems
6	Evaluation	Advantages and limitations of alternative approaches

Session	Topic	Level
1	Introduction to GIS in Water Resources	2
2	Introduction to ArcGIS	2
3	Exercise 1: Introduction to ArcGIS	3
4	Data sources for GIS in water resources	2
5	Geodesy, Map Projections and Coordinate Systems	4
6	Exercise 2: Building a Base Map for the San Marcos Basin	3
7	Spatial analysis using rasters	4
8	Exercise 3: Spatial analysis	4
9	DEMs and watershed delineation	4
10	Hydrologic terrain analysis	3
11	Exercise 4: Watershed and stream network delineation	4
12	National water model	1

Expected Skills

- Convert degree, minute, second coordinates to decimal degrees, and vice versa
- Determine the length of a line along a meridian, parallel or great circle on a spherical earth.
- Determine the length of a line when using projected coordinates.
- Sketch on a map the standard parallels, central meridian, and latitude of origin for a given projection (the coordinates of origin, what earth datum, what projection)
- Determine the statistics (e.g. average value or sum) of an attribute of a selected set of features satisfying a logical query
- Be able to take the parameters of a map projection and interpret what they mean (focus on geographic, UTM, Albers, State Plane and Web Mercator projections)
- Know the common national data sources for GIS in Water Resources and their GIS data formats (vector, raster, point, line, polygon etc.)
- Be able to perform raster calculations for spatial analysis and understand the concepts involved with raster calculation
- Be able to calculate slope on a DEM by point to point methods and by finite difference methods
- Take a small grid of elevation cells, fit pits, calculate the flow direction and flow accumulation grids, and determine the watershed draining to an outlet cell.

- Derive Geomorphologic and Watershed attributes from a DEM derived drainage network. These include, channel length, drainage area, and drainage density.
- Be able to use interpolation tools to obtain spatial fields from point data and explain the function and interpret the output of these tools.
- Be able to use zonal statistics tools to obtain averages of spatial fields such as precipitation and slope over watersheds and catchments. Explain the function and interpret the output from these tools.
- Be able to describe the function of elevation, hydro and landscape services as used in ArcMap

Synopses for Lectures — these show the basic concepts that we are trying to get across in each of these class sessions. Look to these summaries for "Define and Explain" type of questions (Level 1 and 2 in the Bloom's Taxonomy).

Course Videos are viewable at: https://mediasite.engr.utexas.edu/UTMediasite/Catalog/catalogs/fall-2017-gis-maidment

Readings from ArcGIS Desktop Help

(1) Geodesy, Map Projections and Coordinate Systems (Level 4)

What are Map Projections
http://desktop.arcgis.com/en/arcmap/latest/map/projections/what-are-map-projections.htm
Geoid, Ellipsoid, Spheroid and Datum
http://desktop.arcgis.com/en/arcmap/latest/map/projections/about-the-geoid-ellipsoid-spheroid-and-datum-and-h.htm
Geographic Coordinate Systems
http://desktop.arcgis.com/en/arcmap/latest/map/projections/about-geographic-coordinate-systems.htm
Projected Coordinate Systems
http://desktop.arcgis.com/en/arcmap/latest/map/projections/about-projected-coordinate-systems.htm

(2) Raster Data and Spatial Analyst (Level 4)
What is raster data?
http://desktop.arcgis.com/en/arcmap/latest/manage-data/raster-and-images/what-is-raster-data.htm
Fundamentals of raster data from Cell size of raster data to Raster dataset attribute tables
http://desktop.arcgis.com/en/arcmap/latest/manage-data/raster-and-images/cell-size-of-raster-data.htm
ArcGIS Pro An overview of the Spatial Analyst Toolbox
https://pro.arcgis.com/en/pro-app/tool-reference/spatial-analyst/an-overview-of-the-spatial-analyst-toolbox.htm.

(3) Slope and Aspect (Level 4)
How Slope Works
https://pro.arcgis.com/en/pro-app/tool-reference/spatial-analyst/how-slope-works.htm
How Aspect Works
https://pro.arcgis.com/en/pro-app/tool-reference/spatial-analyst/how-aspect-works.htm
Slope Handout
http://hydrology.usu.edu/dtarb/giswr/2016/Slope.pdf

(4) Hydrology Tools (**Level 4**)
https://pro.arcgis.com/en/pro-app/tool-reference/spatial-analyst/an-overview-of-the-hydrology-tools.htm to end of Hydrologic analysis sample applications in the Hydrology toolset concepts

For the quiz you will need a calculator and it would be good to have a straight edge to help you draw nice diagrams in your answers.

You may bring into the quiz an 8.5" x 11" review sheet with anything you want written on it, front and back. You are not allowed to have access to any other reference materials.