# GIS in Water Resources Review for Midterm Exam Fall 2010

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 software 2

3 Exercise 1: Introduction to HydroDesktop 3

4 Data sources for GIS in water resources 2

5 Exercise 2: Building a Base Map for the San Marcos Basin 3

6 Geodesy, Map Projections and Coordinate Systems 4

7 Spatial analysis using grids 4

8 Exercise 3: Spatial analysis 5

9 DEM’s, watershed and stream network delineation 4

10 Exercise 4: Watershed and stream network delineation 5

11 Network analysis, NHDPlus 2

12 Exercise 5: Flow networks and basin precipitation 2

**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 map extent of a set of geographic data
* 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 and State Plane 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 and calculate the flow direction and flow accumulation grids
* Define the watershed of a cell in a DEM grid
* 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 analyze spatial aspects of the water balance (precipitation, streamflow, and runoff ratios) to develop a spatial understanding of the hydrologic flows in a river basin
* Understand how geometric networks are created and how catchments and attributes are connected to flowlines in the NHDPlus.
* Understand the concept of a time-enabled feature layer in ArcGIS 10

**Readings from ArcGIS Desktop Help for Version 10**

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| **Concept** | **Reading Material**  | **Level** |
| 1. ArcGIS introduction | ArcGIS brochures | 2 |
| 2. GIS basics | Essentials Library/Elements of geographic information | 2 |
| 3. Geodesy, map projections and coordinate systems  | Professional library/ Guide books/ Map projections | 4 |
| 4. Rasters and images | Professional library/ Data Management/ Geographic Data Types/ Rasters and Images | 3 |
| 5. Hydrology tools | Professional Library/ Geoprocessing/ Geoprocessing tool reference/Spatial Analyst toolbox/ Hydrology toolset | 5 |
| 6. Geometric networks | Professional Library/ Data Management/ Geographic Data Types/ Geometric Networks | 2 |
| 7. Linear referencing  | Professional Library/ Guide books/ Linear Referencing | 2 |