CE 5364 Groundwater Transport Phenomena
Exercise Set 1

Exercises

1. A sand column has the following characteristics[1]:

$$K = 10^{-4}\frac{cm}{s} A = 75cm^2 \frac{dh}{dl} = 0.01n = 0.20$$

   Determine:

   (a) Sketch the system.

   (b) The discharge velocity.

   (c) The seepage velocity.

   (d) The volumetric flow rate through the column.

2. Assuming that all water in the oceans is involved in the hydrologic cycle, estimate the average residence time of ocean water. [Problem 1.1.1 in Chow, Maidment, and Mays]

3. Assuming that all surface runoff to the oceans comes from rivers, estimate the average residence time of water in rivers. [Problem 1.1.2 in Chow, Maidment, and Mays]

4. The equation $k\frac{dQ}{dt} + Q(t) = I(t)$ has been used to describe the response of streamflow to a constant rate of precipitation continuing indefinitely on a watershed. For this problem, let $I(t) = 1$ for $t > 0$ and $Q(t) = 0$ for $t = 0$. Plot values of $I(t)$ and $Q(t)$ over a 10-hour period if $k = 2$. [Problem 1.3.2 in in Chow, Maidment, and Mays][2]

[1] Problem 2-3, pg. 578 in Bedient, et. al.

[2] You will need to solve the differential equation

5. Figure **??** is a schematic of a 600-hectare farm; the land receives annual rainfall of 2500 mm. There is a river flowing through the farm land with inflow rate of 5 m^3/s and outflow rate of $4m^3/s$. The annual water storage in the farm land increases by $2.5\times10^6 m^3$. Using the water budget concept, estimate the annual evaporation amount in millimeters.[3]

Figure 1: Schematic of Farmland

6. A reservoir has a surface area of 690 acres. Figure **??** shows the monthly inflow of surface water, outflows as releases from the reservoir via the spillway, direct precipitation into the reservoir, and evaporation from the reservoir. The reservoir water surface elevation was 701.0 feet on January 1. Determine the reservoir water surface elevation at the end of each month (i.e. complete the table)

Figure 2: Tabular Water Budget Values

[3] 1 hectare = 10,000 m^2