EVE 290
Introduction to Environmental Engineering

Homework #12

1. Two rivers (R_1, R_2) flow into a large, completely mixed lake, and two rivers (R_3, R_4) flow out. The rivers have volumetric flow rates and DDT concentrations as shown below:

$Q_1 = 3.6\ m^3/s$	$Q_2 = 1.4\ m^3/s$	$Q_3 = ?$	$Q_4 = 2.8\ m^3/s$
$C_1 = 2.1\ \mu g/m^3$	$C_2 = 0\ \mu g/m^3$	$C_3 = 1.7\ \mu g/m^3$	$C_4 = ?$

   Determine Q_3 and C_4. Clearly state all assumptions. (**Ans: $Q_3 = 2.2\ m^3/s$, $C_4 = 1.36\ \mu g/m^3$**)

2. A lagoon is to be designed to accommodate an input flow of 0.10 m^3/s of non-conservative pollutant with concentration 30.0 mg/L and reaction rate 0.20 day^{-1}. The effluent from the lagoon must have a pollutant concentration of less than 10.0 mg/L. Assuming complete mixing, how large must the lagoon be? (**Ans: 86,400 m^3**)

3. A college bar with volume 500 m^3 has 50 smokers in it, each smoking two cigarettes per hour. An individual cigarette emits, among other things, about 1.4 mg of formaldehyde (HCHO). Formaldehyde converts to carbon dioxide with a reaction rate coefficient of k = 0.40 hr^{-1}. Fresh air enters the bar at the rate of 1000 m^3/hr, and stale air leaves at the same rate. Assuming complete mixing, estimate the steady-state concentration of formaldehyde in the air. (**Ans: 0.117 mg/m^3**).

4. Consider a 10×10^6 m^3 lake fed by a polluted stream with a flow rate of 5 m^3/s and a pollutant concentration of 10 mg/L. There is also a sewage outfall that discharges 0.5 m^3/s of wastewater with a pollutant concentration of 100 mg/L. Stream and sewage wastes have a reaction rate coefficient of 12% per day. Find the steady-state (i.e., effluent) pollutant concentration and flow rate.