Lafayette College
Department of Civil and Environmental Engineering

CE 321: Environmental Engineering and Science **Fall 2019**

Guidelines for Engineering Homework

General Guidelines for text-based questions

1) Restate questions
2) All text-based questions - presentation on plain-typing paper is fine. If hand-written, work is to be presented on engineering paper. Typed work for text-based questions is preferred.
3) Identification Information - Name, due date, class, assignment #, etc.
4) Keep answers concise
5) Properly constructed paragraphs with heading and subheading, where appropriate
6) General format guidelines:
    a. 1" margins all around
    b. Line spacing - 1.5
    c. 12 point Times Roman font
    d. Proper us of "Headings and Subheading"
7) References – Presented in American Psychological Association (APA) format

General Guidelines for problem-based questions (Particularly Homework's 2 through 4)

1) Clearly present problem through the **Problem Statement** (restate problem)
2) Identify what is **Known/Given**.
3) What is the problem statement asking to **Find**.
4) List all **Assumptions**.
    a. Typical Assumptions to Consider:
        i. Is the temperature constant?
        ii. What order is the reaction?
        iii. Is the system at SS or NonSS?
        iv. What type of reactor have you defined?
        v. Is the pollutant conservative or nonconservative?
        vi. Gains or losses due to things like percolation or evaporation?
        vii. Are the flows and/or concentrations entering and leaving constant?
        viii. Is k considered to be constant?
5) Draw a Diagram of the system (**Free Body Diagram (FBD)**).
6) **Solve** the problem in a *step-by-step manner*.
7) Clearly identify **key information** by **underlining** to draw attention.
8) Clearly identify what you are asked to find by **boxing the answer**.

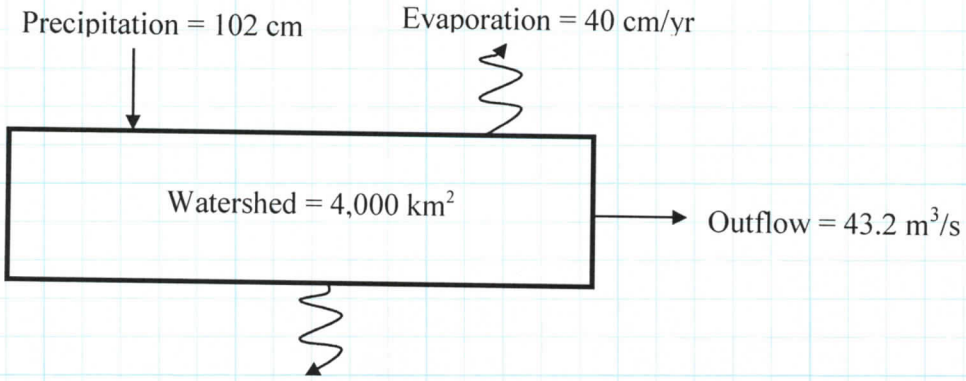
Detailed Guidelines

A) Problem Solution Procedure
   1) Assign a title or heading for your work.
   2) State the problem in your own words (briefly and concisely). Indicate the known information and the information/question to be found/solved.
   3) When appropriate, include a sketch of the systems to be analyzed (free body diagram, circuit diagram, kinetic diagram, closed system, control volume, etc.). Select and label a coordinate system.
   4) State the boundary conditions or label the boundaries. State any constraints on the problem.
   5) Give the appropriate mathematical statements of the physical laws that are necessary to solve the problem.
   6) List all assumptions.
   7) Perform the analysis (algebraically or numerically) to obtain your answer.
   8) Identify your answer by boxing it; include the units. Remember the number of significant figures appropriate for your work.
   9) Check your answer for reasonableness. Review assumptions. Check consistency of units used.
   10) Review your work for common errors such as signs, errors, etc.

B) Be certain your name and due date is included in the heading of your work.

C) Format Requirements
   1) All work is to be done on 8.5 x 11 inch **Lafayette College Engineering Paper**. If needed, use graph paper. Use only the front side of the paper.
   2) Use pencil (2H or softer) and eraser. Print all words.
   3) Use rulers, straight edges, templates, French curves, protractors, etc. for all drawings, sketches and graphs.
   4) Work sequentially down the page. Do not crowd your work. Be neat, legible and unambiguous.

3. A 4,000-km^2 watershed receives 102 cm of precipitation in one year. The average flow of the river draining the watershed is 43.2 m^3/s. Infiltration is estimated to be 5.5 X 10^{-7} cm/s and evapo-transpiration is estimated to be 40 cm/y. Determine the change in storage in the watershed over one year. (report your answer as m^3) The ratio of runoff (in cm) to precipitation is termed the runoff coefficient. Computer the runoff coefficient for this watershed.



Known:

Precipitation = P = 102 cm/y

Evaporation = E = 40 cm/y

Watershed Area = 4,000 km^2

Infiltration = I = 5.5 x 10^{-7} cm/y

Runoff = Outflow = O = 43.2 m^3/s

Find:

a) Change in Storage over one year = ΔS/y
b) Ratio of runoff (cm) to perception = runoff coefficient

Assumption:

No additional reactions, Water activity is as defined…no other source or removals, constant temp.

Solution:

$\Delta S/y = P - E - I - O$

$$\text{Runoff} = O = \frac{(43.2\ m\text{^}3/s)(86{,}400\,{}^{s}/_{d})(365\,{}^{d}/_{y})(100\,{}^{cm}/_{m})}{(4{,}000 km^2)\left(1x10^6\,{}^{m^2}/_{km^2}\right)} = 34.05 \text{ cm/y}$$

$$I = (5.5\ x\ 10^{-7}\,{}^{cm}/_{s})\left(86{,}400\,{}^{s}/_{d}\right)\left(365\,{}^{d}/_{y}\right) = 17.34 \text{ cm/y -}$$

a) $\Delta S/y = 102\ cm/y - 40\ cm/y - 40\ cm/y - 34.05\ cm/y =$ **10.61 cm/y**

OR

ΔS for one year reported as Volume (m^3) considering a watershed area of 4,000 km^2

$$\text{Volume} = (10.61\ {}^{cm}/_{y})(1\ y)(10^{-2}\ {}^{m}/_{cm})(4{,}000\ km^2)\left(1\ x\ 10^{6}\ {}^{m^2}/_{km^2}\right) = \mathbf{4.2\ x\ 10^8\ m^3}$$

b) Runoff coefficent $C = \frac{runoff}{preciptation} = \frac{34.05\ cm}{102\ cm} =$ **0.3333 or 33.33%**