NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
FACULTY OF INDUSTRIAL TECHNOLOGY
DEPARTMENT OF CIVIL AND WATER ENGINEERING
BACHELOR OF ENGINEERING (HONS) DEGREE
PART III SECOND SEMESTER EXAMINATIONS – May 2014

WATER RESOURCES MANAGEMENT – TCW 3201

Instructions

Answer **all** questions — Time: 3 Hours

Supplementary information follows the questions — Total marks: 100

Question 1

a. Most international organizations involved in resource management (e.g., United Nations, World Health Organization, World Bank) now advocate the use of Integrated Water Resource Management (IWRM), rather than traditional Water Resource Management (WRM). Briefly explain what distinguishes IWRM from WRM.

(10 marks)

b. The river basin is typically advocated as the most appropriate unit for implementation of IWRM, although there are some drawbacks with this approach. Briefly explain why river basins are usually recommended. Include in your explanation not only the advantages of river basin IWRM, but also at least two examples of challenges or drawbacks caused by this choice (of the river basin as the planning and implementation unit for management).

(15 marks)

Question 2

Plateau Creek carries 5.0m^3/s of water with a selenium (Se) concentration of 0.0015mg/L. A farmer starts withdrawing 1.0m^3/s of the creek water to irrigate her land. During irrigation the water picks up selenium from the salts in the soil. One half of the irrigation water is lost to the ground and plants, while the other half is returned to Plateau Creek. The irrigation run-off to the creek contains 1.00mg/L of selenium. Selenium is a conservative, non-reactive substance (it does not degrade in the stream) and the stream does not pick up more selenium from any other source.

a. If the farmer irrigates continuously, what will be the steady-state concentration of selenium in the stream downstream from the farm (after the irrigation run-off returns to the stream)?

(10 marks)

b. Fish are sensitive to selenium levels over 0.04mg/L. The farmer agrees not to use more water than will keep the stream selenium level below this critical concentration. How much water can she withdraw from the stream to use for irrigation?

(15 marks)

c. Decreasing the amount of water withdrawn from the stream for farm use is one way by which to decrease the amount of selenium the farm run-off contributes to Plateau Creek. Discuss another way to achieve this end and briefly explain both an advantage and a disadvantage of this alternative. **(5 marks)**

Question 3

You must choose between two alternatives for providing a new source of water to augment a municipal supply. One alternative is to develop a new groundwater field by drilling bores and installing pumps and pipes to connect with the current system. The second alternative is to remediate (by dredging) the polluted sediments in a river so its water becomes suitable to be used with the existing municipal supply.Both alternatives will produce the same amount of water, have a 30 year design life, and each will take 3 years to implement with water production starting the beginning of year 4. Because this is a public works financed project the discount rate is a relatively low 8%. (Assume depreciation, salvage value, and inflation are all negligible.) The cost components for two alternatives are shown below.

Alternative 1: New well field.

1. Drilling equipment hire and operation (s o y, yr 1-3) $250,000/yr
2. Capital equipment purchase& installation (e o y, yr 1-3) $110,000/yr
3. Capital Equipment O&M (e o m, yr4-25) $7,000/mon + 0.02%/mon incr.

Alternative 2: River remediation.

1. Dredge equipment hire & operation (e o y, yr 1-3) $119,000/yr
2. Hazardous waste Disposal (e o q, yr 1-3) $87,000/quarter
3. Capital equipment purchase & installation (e o y, yr 1-3) $51,000/yr
4. Capital Equipment O&M (e o m, yr 4-25) $2,000/mon + $5/mon increment

a. Which of the alternatives would you choose based on present worth? For credit you must show the calculations supporting your choice.

(20 marks)

b. There are intangibles involved in both alternatives. Suggest an intangible for <u>each</u> alternative.Discuss how each alternative's intangible might influence your decision.

(10 marks)

Question 4

a. The evolutionary, adaptive process of implementing IWRM is conceptualized as a spiral model with four stages in each full circle of the spiral. Identify three of the four stages and briefly discuss what activities take place in each of those three.

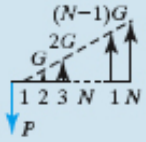
(6 marks)

b. Why are the Dublin Principles of importance in IWRM? **(3 marks)**

c. Name three of the Dublin Principles. For each of the three Dublin Principles you identify, how do they influence action and decision-making in IWRM?

(6 marks)

TABLE 2.10 Formula Summary Table

Flow Type	Factor Notation	Formula	Excel Command	Cash Flow Diagram
SINGLE	Compound amount (*F/P, i, N*)	$F = P(1+i)^N$	= FV(i%, N, 0, P)	
	Present worth (*P/F, i, N*)	$P = F(1+i)^{-N}$	= PV(i%, N, 0, F)	
EQUAL PAYMENT SERIES	Compound amount (*F/A, i, N*)	$F = A\left[\frac{(1+i)^N - 1}{i}\right]$	= FV(i%, N, **A**)	
	Sinking Fund (*A/F, i, N*)	$A = F\left[\frac{i}{(1+i)^N - 1}\right]$	= PMT(i%, N, 0, F)	
	Present worth (*P/A, i, N*)	$P = A\left[\frac{(1+i)^N - 1}{i(1+i)^N}\right]$	= PV(i%, N, **A**)	
	Capital recovery (*A/P, i, N*)	$A = P\left[\frac{i(1+i)^N}{(1+i)^N - 1}\right]$	= PMT(i%, N, P)	
GRADIENT SERIES	Linear gradient Present worth (*P/G, i, N*)	$P = G\left[\frac{(1+i)^N - iN - 1}{i^2(1+i)^N}\right]$		
	Equal-Payment Conversion factor (*A/G, i, N*)	$A = G\left[\frac{(1+i)^N - iN - 1}{i[(1+i)^N - 1]}\right]$		
	Geometric gradient Present worth ($P/A_1, g, i, N$)	$P = \begin{bmatrix} A_1\left[\frac{1-(1+g)^N(1+i)^{-N}}{i-g}\right] \\ A_1\left(\frac{N}{1+i}\right), (\text{if } i = g) \end{bmatrix}$