NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
FACULTY OF INDUSTRIAL TECHNOLOGY
DEPARTMENT OF CIVIL AND WATER ENGINEERING
BACHELOR OF ENGINEERING (HONS) DEGREE
PART III: SUPPLEMENTARY EXAMINATION- AUGUST 2014

WATER RESOURCES MANAGEMENT – TCW 3201

Instructions

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

Supplementary information follows the questions — Total marks: 100

Question 1

a. The amount of water humans require for health and survival is considerably greater than that needed simply for drinking. Briefly discuss other components in human water demand, which the water resource manager must consider in providing an adequate supply to meet direct human needs in a city such as Bulawayo. Your discussion should include the relative amounts, compared to drinking water, required for these other components. **(12 marks)**

b. Briefly describe what the term "embedded water" means and how it impacts quantification of the water demand which a water resource manager must undertake. **(7 marks)**

c. Briefly describe what is meant by "global virtual water trading" and how it might likely affect southern African countries such as Zimbabwe. **(6 marks)**

Question 2

A dam stores water from a river for agricultural and urban use. The river flow into the reservoir averages1.13 m^3/s and the dam discharges a constant 0.34 m^3/s downstream. The surface area of the dam's impounded water is 0.430 km^2 and the submerged sediment area is 0.493 km^2. The infiltration rate through the sediment's underlying the reservoir is 2.45 mm/h and the evapotranspiration rate from the reservoir free water surface is 2.89 mm/d. In addition, 36.5 m^3/min of water is taken from the dam for human use.

a. Is the reservoir filling or emptying? **(4 marks)**

b. What is the change in stored water volume in the dam daily? **(11 marks)**

c. Assuming the surface area of the impounded water is relatively independent of the volume of water in the dam (for small changes in elevation), how long will it take for the water surface elevation to change 50 cm? **(5 marks)**

d. Assuming all other input and outputs from the reservoir are unchanged, what would be the sustainable downstream discharge rate of water from the reservoir? **(5 marks)**

Question 3

A public works water project will cost $25,000,000 now and will require $2,000,000 in operation and maintenance expenditures annually over its projected 25 year design life. The effective annual interest rate is 12%.

a. If the total money to finance all of the project costs (capital plus O&M) is to be raised now, how much money would need to be raised? **(12 marks)**

b. It is projected that the project will generate $5,000,000 immediately upon completion in one year and will generate $2,250,000 plus 0.5% annually thereafter for the duration of the project life. From a strict, economic cost-benefit analysis, should the project be undertaken? **(13 marks)**

Question 4

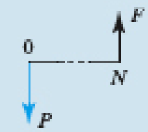
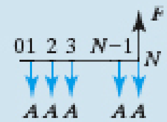
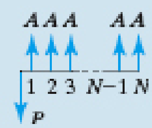
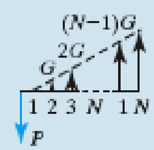
a. The Southern African Vision for Water has been formulated based on three key policy principles known as the "E" principles. A holistic and integrated water management policy requires a water policy based on such principles. Name the 3 "E" policy principles and briefly describe the meaning of each. **(9 marks)**

b. Destruction of ecosystems penalizes everyone. In addition to food and energy, name three "common to all" benefits of managing and planning for a healthy ecosystem. **(6 marks)**

c. Why are the Dublin Principles of importance in IWRM? **(4 marks)**

d. 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 $(F/A, i, N)$	$F = A\left[\dfrac{(1+i)^N - 1}{i}\right]$	= FV(i%, N, A)	
	Sinking Fund $(A/F, i, N)$	$A = F\left[\dfrac{i}{(1+i)^N - 1}\right]$	= PMT(i%, N, 0, F)	
	Present worth $(P/A, i, N)$	$P = A\left[\dfrac{(1+i)^N - 1}{i(1+i)^N}\right]$	= PV(i%, N, A)	
	Capital recovery $(A/P, i, N)$	$A = P\left[\dfrac{i(1+i)^N}{(1+i)^N - 1}\right]$	= PMT(i%, N, P)	
GRADIENT SERIES	Linear gradient Present worth $(P/G, i, N)$	$P = G\left[\dfrac{(1+i)^N - iN - 1}{i^2(1+i)^N}\right]$		
	Equal-Payment Conversion factor $(A/G, i, N)$	$A = G\left[\dfrac{(1+i)^N - iN - 1}{i[(1+i)^N - 1]}\right]$		
	Geometric gradient Present worth $(P/A_1, g, i, N)$	$P = \begin{bmatrix} A_1\left[\dfrac{1-(1+g)^N(1+i)^{-N}}{i-g}\right] \\ A_1\left(\dfrac{N}{1+i}\right), (\text{if } i = g) \end{bmatrix}$