

**NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
FACULTY OF INDUSTRIAL TECHNOLOGY
BACHELOR OF ENGINEERING (HONS) DEGREE
DEPARTMENT OF CIVIL AND WATER ENGINEERING
PART III SECOND SEMESTER EXAM INATIONS – MAY 2011**

WATER RESOURCES MANAGEMENT – TCW 3201

Instructions:

Answer any four questions

Time:

3 Hours

Total marks:

100

QUESTION 1

- a. State and explain the Dublin principles as applied to IWRM **(10 marks)**
- b. Outline the steps involved in planning water resources projects. **(5 marks)**
- c. For a typical water resources project such as multipurpose large dam construction, explain how you would carry out a stakeholder identification. **(10 marks)**

QUESTION 2

One of 2 water resources projects A or B is being considered for implementation. The predicted costs and benefits from both projects are given in Table Q2. Phases I and II of Project A commence at the beginning of years 1 and 11, respectively, while those of Project B commence at the beginning 1 and 16.

Table Q2

Item	Project (\$million)	
	A	B
Cost at beginning of Phase I	2.8	8.9
Cost at beginning of Phase II	10	50
Annual OMR cost in Phase I	0.2	0.8
Annual OMR cost in Phase II	0.75	2.1
Benefits at the end of 1 st 5 years	3.2	5.6
Benefits at the end of 2 nd 5 years	12.4	22.2
Benefits at the end of 3 rd 5 years	25	43.1
Benefits at the end of 4 th years	40	60.5
Benefits at the end of 5 th 5 years		72
Benefits at the end of 6 th 5 years		76

Using a nominal interest rate of 10%, calculate:

- a. The present value of the net benefits for both projects **(15 marks)**
- b. The uniform yearly net benefits for both projects **(8 marks)**
- c. Which is the preferred project and why? **(2 marks)**

QUESTION 3

- a. Derive an expression for the series of annual payments that should be made in T number of years that are equivalent to a present value PV when the prevailing annual interest rate is r. **(8 marks)**

- i. \$50,000 in 15 years at 10% compound annually
- ii. \$50,000 in 15 years at 10% compound monthly
- iii. \$50,000 in 15 years at 10% compound continuously **(7 marks)**

c. Discuss the advantages and disadvantages of the Benefit-Cost Ratio using typical examples **(10 marks)**

QUESTION 4

a. What is system analysis as applied to water resources management? **(5 marks)**

b. 3 farmers whose plots of land adjoin a reservoir can be allocated a total of 4 units of water from the reservoir. If the net benefit functions from these 3 farmers are as follows:

Farmer	Allocation	Net Benefit function from agric production, NB (x_i)
1	X_1	$6x_1 - x_1^2$
2	X_2	$12x_2 - 3x_2^2$
3	X_3	$9x_3 - 1.5x_3^2$

Determine how these units of water can be allocated so that the total net benefits from these 3 farmers is optimal by the

- i. Lagrange multiplier method
- ii. Dynamic programming method **(20 marks)**

QUESTION 5

a. Discuss the challenges associated with operating a single reservoir for multipurpose. **(5 marks)**

b. The amounts of water flowing from a certain catchment area in each successive month are given below in units of $1 \times 10^6 \text{ m}^3$.

flow	2.83	3.40	5.66	18.4	23.75	23.75	20.4	9.34	7.36	6.79	6.23	5.95
month	1	2	3	4	5	6	7	8	9	10	11	12

i. Determine the minimum capacity of a reservoir if the above water is to be drawn off at a uniform rate and none is to be lost by flow over the spillway and the amount of water which must be initially stored to maintain the above uniform draw off. **(10 marks)**

ii. If the amount of water initially stored is $4 \times 10^6 \text{ m}^3$, what will be the maximum possible uniform draw off and the amount lost by flow over the spillway during the year assuming that the total reservoir capacity is unaltered? **(10 marks)**