University Of Technology
Building and Construction Eng. Dept.
Final Exam – First Attempt – 2012/2013

Subject :Management And Economic of Water Resources — Cass:4th Year

Branch : Dams and Water Eng. — Time : 3 Hours

Date : 17/ 6 / 2013

Answer Five Questions Only

Q1: Answer the followings:

A)Explain the system analysis , and discuss the points which should used in project formulation .

B)State the typical input data which must be used in water resources projects.

C)In economical analysis , what are the steps which should be used to optimize the cost of engineering projects.

Q2:There are four reservoirs used to supply water to domestic and industrial uses . The annual profit from these reservoirs are (10 000 , 30 000 , 25 000 , 50 000)MID/annual BCM releases . The management of these reservoirs was subjected to the following restrictions:

1- The maximum annual volume of water which will be used in the project is (5)BCM.

2- The capacities of the reservoirs are (4 , 6 , 5 , and 8) BCM respectively.

3- The inflows to each reservoir are (0.8 , 1.5 , 1 , and 2) BCM respectively

4- The initial storage of each reservoir at the beginning of the year are (4 , 6 , 6 , and 7) BCM respectively .

Formulate and solve the optimization problem to find the annual (BCM) which will be releases from the reservoirs with maximum profit.

Q3 :The irrigation water is to be conveyed to agricultural land by three canals . The cost of the conveying in (BID) was related to the discharge passing across them as shown in the following equations:

$$C_1 = 105Q_1^{-1..5} \quad , \quad C_2 = 80Q_2^{-1.4} \quad , \quad C_3 = 120Q_3^{-1.3}$$

The restriction in this project that the total discharge must not Increase (100 CUMS) .

Distribute the discharge on the canals to provide minimum

- cost of conveying.

Q4: An irrigation project is want to be constructed .The project was divided into several activities and the period of completion them was estimated as shown in table below:

Activity	Period (Month)	Activity	Period (Month)
1-2	4	5-10	10
2-3	4	6-7	6
2-4	7	7-9	14
2-5	4	8-9	7
3-10	15	9-10	14
4-8	7		

The restrictions in these estimations contains:

1-The activity (6-7) begins after completing the activities (2-3), (2-4) .

2- The activity (8-9) begins after completing the activities(6-7), (2-5) .

Draw the network of project planning and find the critical path, early and late beginning , end of the project and each activity.

Q5: The water resources company want to construct (6) pipe culverts of length (8)m to convey irrigation water to an agriculture area. The cost of construction them multiply by (100ID per meter length) contains the following (also per meter length):

1- The excavation works is equal to (30 000)ID, and is varying directly with the square culvert's diameter.

2- The concrete works is equal to (200 000)ID , and is varying directly with the culvert's diameter.

3- The finishing works is equal to (50 000)ID , and is varying with the inverse of square culvert's diameter.

The rate of interest and depreciation for all above costs is (10%) .

Find the optimal diameter of culverts which gives minimum cost , and then find the total cost of construction them if it contains also (3 million ID) for pavement works over each culvert.

Q6: Two power stations are wanted to be used to supply energy . The function of cost in (BID) is related to discharge , head of water, and the horsepower which is given by the following relation:

$$C = 50A + 70B$$

Where (A , B) are the types of power stations . The following restrictions are adopted:

1- The discharge used is not more than (7 CUMS) and the two types used (2 , 3) CUMS respectively.

2- The water head needed is not less than (12)m and the two types work on (8 , 10)m respectively.

3- The produced horsepower is not more than (80)HP and the two types product (50,40) HP respectively.

Formulate and solve the problem to find the minimum cost .

GOOD LUCK

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Q1

A-)) System Analysis : is a process of generating information upon which a resource allocator can base a decision. It involves detailing of how men, money, and materials which shond be combined to adheive alang purpose.

project formulation:

1- Boundary condition
2- land use and water use.
3- Alternative plans.
4- preliminary plans and cost
5- Benefits.
6- Economic possibilities.
7- Combination of project.
8- Selection of best combination.
9- Preperation of report.

B-)) Typical input data for water resource project:

1- Discharge rate.
2- Workmen.
3- Land.
4- Construction material
5- Mechanical Equipment.
6- Energy.

C-)) In economical analysis the following steps are taken:

1- Formulation the expression for the total amount of annual cost of project.

2- Express all the variables in the expression in the term of one single variable.

3- Differentiate the expression cost with respect to the single variable

Q.2

$$P = 10000X_1 + 30000X_2 + 25000X_3 + 50000X_4$$

$$X_1 + X_2 + X_3 + X_4 \leq 5$$

$$S + I - X \leq C$$

$$4 + 0.8 - X_1 \leq 4 \Rightarrow X_1 \geq 0.8$$

$$6 + 1.5 - X_2 \leq 6 \Rightarrow X_2 \geq 1.5$$

$$6 + 1 - X_3 \leq 5 \Rightarrow X_3 \geq 2$$

$$7 + 2 - X_4 \leq 8 \Rightarrow X_4 \geq 1$$

$$X_1 - S_a = 0.8 \Rightarrow S_a = -0.8 + X_1$$

$$X_2 - S_b = 1.5 \Rightarrow S_b = -1.5 + X_2$$

$$X_3 - S_c = 2 \Rightarrow S_c = -2 + X_3$$

$$X_4 - S_d = 1 \Rightarrow S_d = -1 + X_4$$

$$X_1 + X_2 + X_3 + X_4 + S_e = 5 \rightarrow S_e = 5 - X_1 - X_2 - X_3 - X_4$$

	1	X_1	X_2	X_3	X_4
P	0	10000	30000	25000	50000
S_a	-0.8	1	0	0	0
S_b	-1.5	0	1	0	0
S_c	-2	0	0	1	0
S_d	-1	0	0	0	1
S_e	5	-1	-1	-1	(-1)

	1	X_1	X_2	X_3	Se
P	250000	-40000	-20000	-25000	50000
S_a	-0.8	1	0	0	0
S_b	-1.5	0	1	0	0
S_c	-2	0	0	1	0
S_d	4	-1	-1	-1	-1
X_4	5	-1	-1	-1	-1

$\therefore X_1 = 0$

$X_2 = 0$

$X_3 = 0$

$X_4 = 5$ BCM

$P = 0 + 0 + 0 + 50000 * 5$

$= 250000$ MID / annual BCM

Q.3 :

$C = C_1 + C_2 + C_3$

$C = 105 Q_1^{-1.5} + 80 Q_2^{-1.4} + 120 Q_3^{-1.3}$

$\lambda (Q_1 + Q_2 + Q_3 = 100)$

$C_\lambda = 105 Q_1^{-1.5} + 80 Q_2^{-1.4} + 120 Q_3^{-1.3} + \lambda (Q_1 + Q_2 + Q_3 - 100)$

$\frac{\partial C}{\partial Q_1} = -157.5 Q_1^{-2.5} + \lambda = 0$ ——— (1)

$\frac{\partial C}{\partial Q_2} = -112 Q_2^{-2.4} + \lambda = 0$ ——— (2)

$\frac{\partial C}{\partial Q_3} = -156 Q_3^{-2.3} + \lambda = 0$ ——— (3)

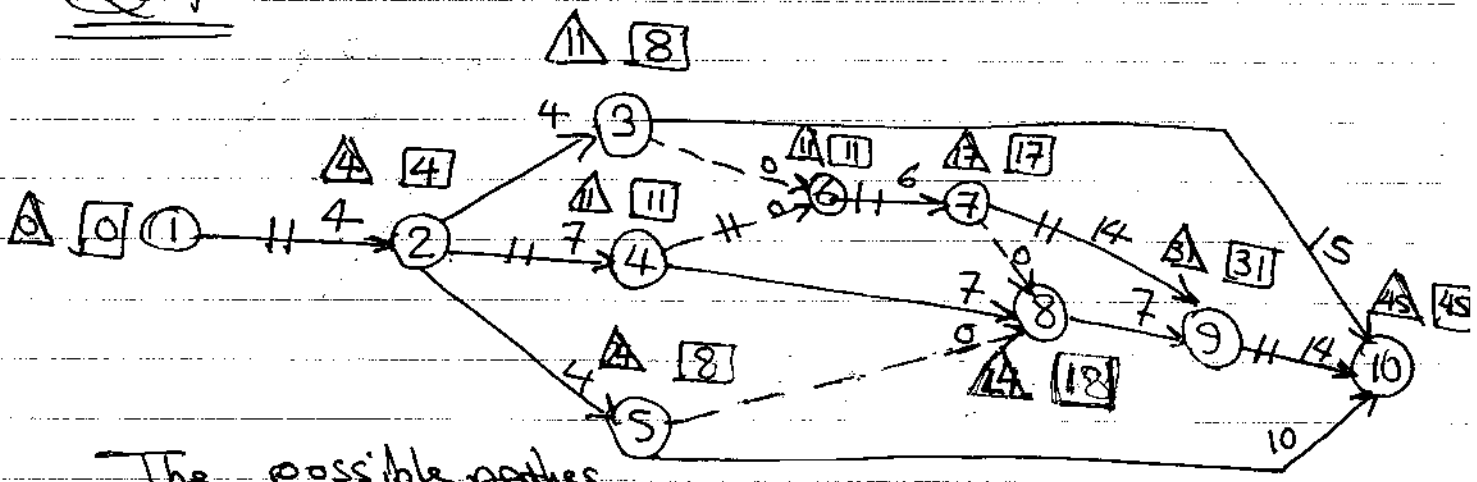
$\frac{\partial C}{\partial \lambda} = Q_1 + Q_2 + Q_3 - 100 = 0$ ——— (4)

By solving the above equations:

$Q_1 = 31$ m³/sec $Q_3 = 42$ m³/sec.

$Q_2 = 27$ m³/sec

Q.4



The possible pathes :

1-2-3-10 = 23 Month
1-2-3-6-7-9-10 = 42 "
1-2-3-6-7-8-9-10 = 35 "
1-2-4-8-9-10 = 39 "
1-2-4-6-7-9-10 = 45 "
1-2-4-6-7-8-9-10 = 38 "
1-2-5-10 = 18 "
1-2-5-8-9-10 = 29 "

The critical path is 1-2-4-6-7-9-10 and its period is (45) month.

Q.5

$C = C_r D$

$C_1 = 30000 * 0.1 * D^2$

$C_1' = 3000 D^2$

$C_2 = 200000 * 0.1 * D = 20000 D$

$C_3 = 50000 * \frac{0.1}{D^2} = 5000 D^{-2}$

$C = 3000 D^2 + 20000 D + 5000 D^{-2}$

$\frac{dC}{dD} = 6000 D + 20000 - 10000 D^{-3} = 0$

By solving this equation $D = 0.74$ m

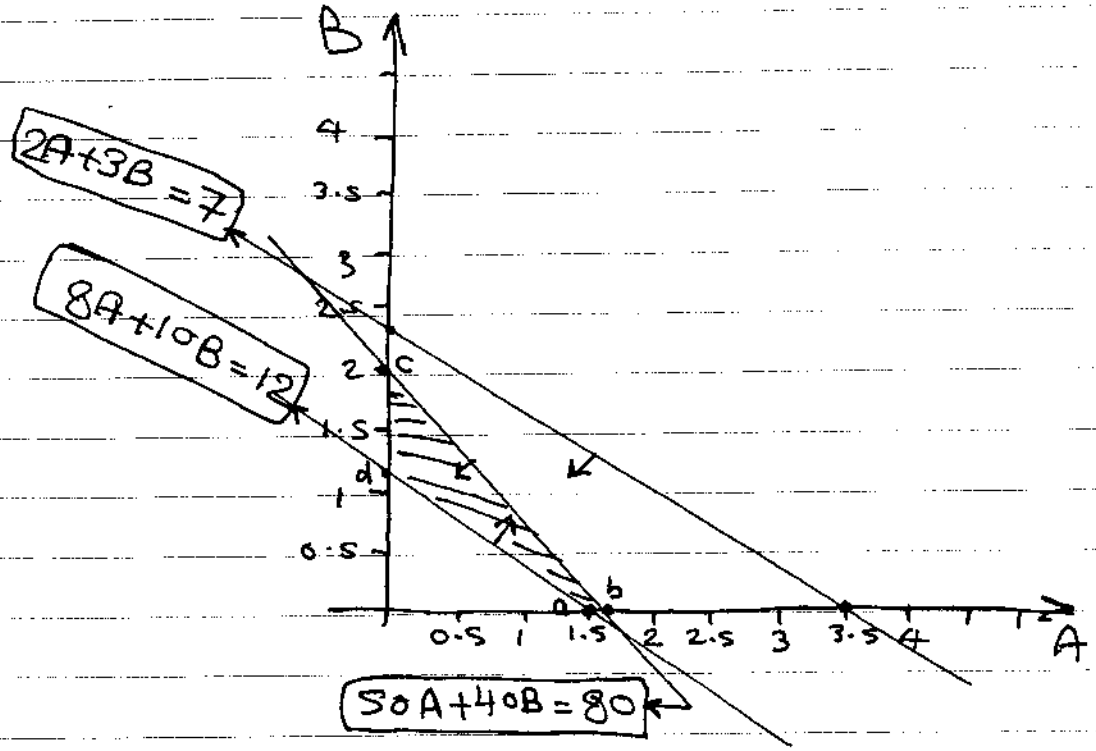
$C = 255735$ ID / m length.

The total cost $= 255735 \times 48 + 3000000 * 6$
$= 1.4 * 10^8$ ID

Q-6

$$C = 50A + 70B$$

$$2A + 3B \leq 7$$
$$8A + 10B \geq 12$$
$$50A + 40B \leq 80$$



point	A	B	C (BID)
a	1.5	0	75
b	1.6	0	80
c	0	2	140
d	0	1.2	84

The minimum cost is (75 BID) at type (A) and point = 1.5