University Of Technology
Building and Construction Eng. Dept.
Final Exam –1st Attempt – 2014/2015

Subject :Management And Economic of Water Resources
Branch : Water and Dams Eng.

Cass:4th Year
Time: 3 Hours
Date: | /6/2015

Answer Five Questions Only and the Marks are equally divided

Q1: Answer the followings:

A)What are the procedures which should be applied in solving the non-linear optimization.

B)What are the water resources data that should be collected in the evaluation of water resources basin.

C)State the procedures of water system analysis

Q2:Three flood protections are to be allocated to avoid floods with unit of labors and materials as shown below:

Structures	Unit of Labors	Unit of Materials	Expected Protection
Reservoirs	1	3	350
Flood Plains	2	2	250
Levees	3	1	300
Available	30	60	----

Find the optimal protection by using simplex method .

Q3: Two power stations are wanted to be used to supply energy. The function of cost in (BID) is given by the following relation:

$$C = 50A + 70B$$

where: (A , B) are the types of power stations.
This function is related to discharge, head of water ,and the horsepower with the following restrictions:

1- The discharge used is not more than (8 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 (6 , 8)m respectively.
3- The produced horsepower is not more than (90)HP and the two types product (30,45) HP respectively.

Formulate and solve the problem to find the minimum cost .

Q4 :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 followingequations:

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

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.

Q5: A dam project was planning to find the optimal construction program. The project was divided into several activities as shown in table below:

Activity	Period (month)		Activity	Period (month)
1-2	4		4-7	12
1-3	10		5-6	6
2-4	8		6-8	4
2-5	7		7-9	13
3-4	4		8-9	8
4-5	6		**********	

The restrictions in this estimations contains:

1- The activity (3-4) begins after completing the activity (1-2).

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

Draw the diagram of planning the project and find the critical path , the early and later beginning of each activity in the project.

Q6: The water resources company want to construct (12) elevated semi-circular concrete canals . These canals are of different lengths and their total lengths are (54)Km . The cost of these canals in (1000)ID per meter length contains the following components (also per meter length):

1- The cost of supplying the canals from the factory is equal to (100 000)ID, and is varying directly with the cubic radius of it.

2- The cost of transporting the canals from the factory to their sites is equal to (10 000)ID , and is varying directly with their radius.

3- The cost of laying the canals is equal to (15 000)ID , and is varying with the inverse of their radius.

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

Find the optimal radius of canals which gives minimum cost , and then find the total cost of construction them

GOOD LUCK

(1)

(1) [illegible]

Q1:

A-) 1- find the number of variables (n)
2- find the number of constraints function (m)
3- The objective function is:
$f_{minimum} = f(X_1, X_2, \dots, X_n)$
subjected to:
$g_j(X) \geq 0$, $j = 1, 2, \dots, m_1$
$g_j(X) = 0$, $j = m_1+1, m_1+2, \dots, m_2$
$g_j(X) \leq 0$, $j = m_2+1, m_2+2, \dots, m$
If $f(n) = 0$ the problem is unconstrained
Always be ... for non-linear optimization

B-) 1- hydrology: the data contains
- Rainfall intensity, duration, frequency
- Rainfall Runoff relationship
- Hydrographs
- Hydrologic analysis
- Evaporation
- ... slope
2- Geology: - ...
- ...
3- Aerial photographs

C-) 1- State the objective of the problem
2- Collection and analysis of data required
3- Established the design criteria
4- Suggest ... of alternative ...
5- find the best design
6- Evaluate the effect of the best design

Q.2: $P = 350X_1 + 250X_2 + 300X_3$

Subjected to:

$X_1 + 2X_2 + 3X_3 \leq 30$

$3X_1 + 2X_2 + X_3 \leq 60$

$X_1 + 2X_2 + 3X_3 + S_a = 30$

$3X_1 + 2X_2 + X_3 + S_b = 60$

	1	X_1	X_2	X_3
P	0	350	250	300
S_a	30	-1	-2	-3
S_b	60	-3	-2	-1

$\Rightarrow$

	1	S_b	X_2	X_3
P	10500	-350	-450	-750
X_1	30	-1	-2	-3
S_a	-30	1/3	4	8

To

$P = 10500$

$X_1 = 30$

$X_2, X_3 = 0$

To check:

$P = 350 * 30 + 0 + 0$

$= 10500$

$\therefore$ O.K.

Q.3:

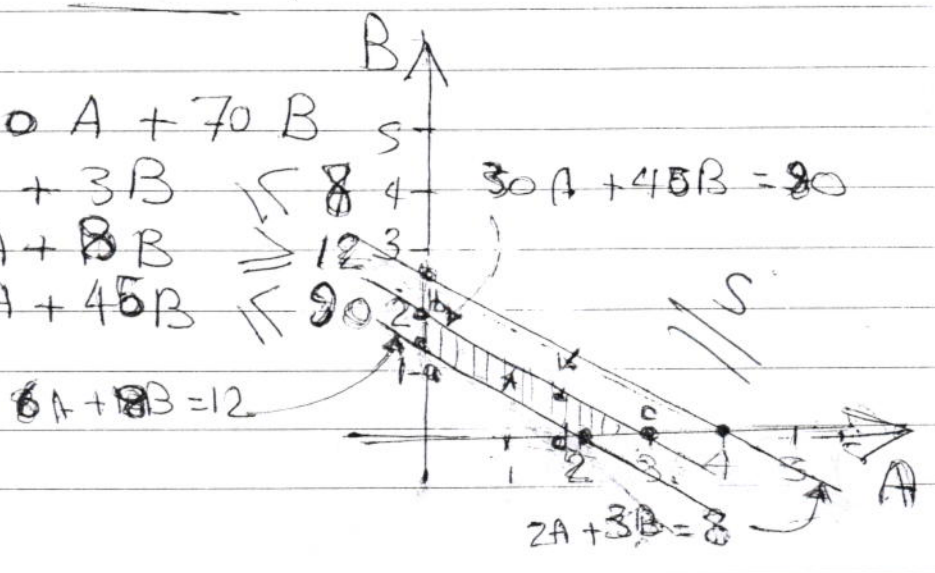
$C = 50A + 70B$

$2A + 3B \leq 8$

$6A + 8B \geq 12$

$30A + 45B \leq 90$

To



point	A	B	cost (BID)
a	0	1.5	105
b	0	2	140
c	2	0	100
d	3	0	150

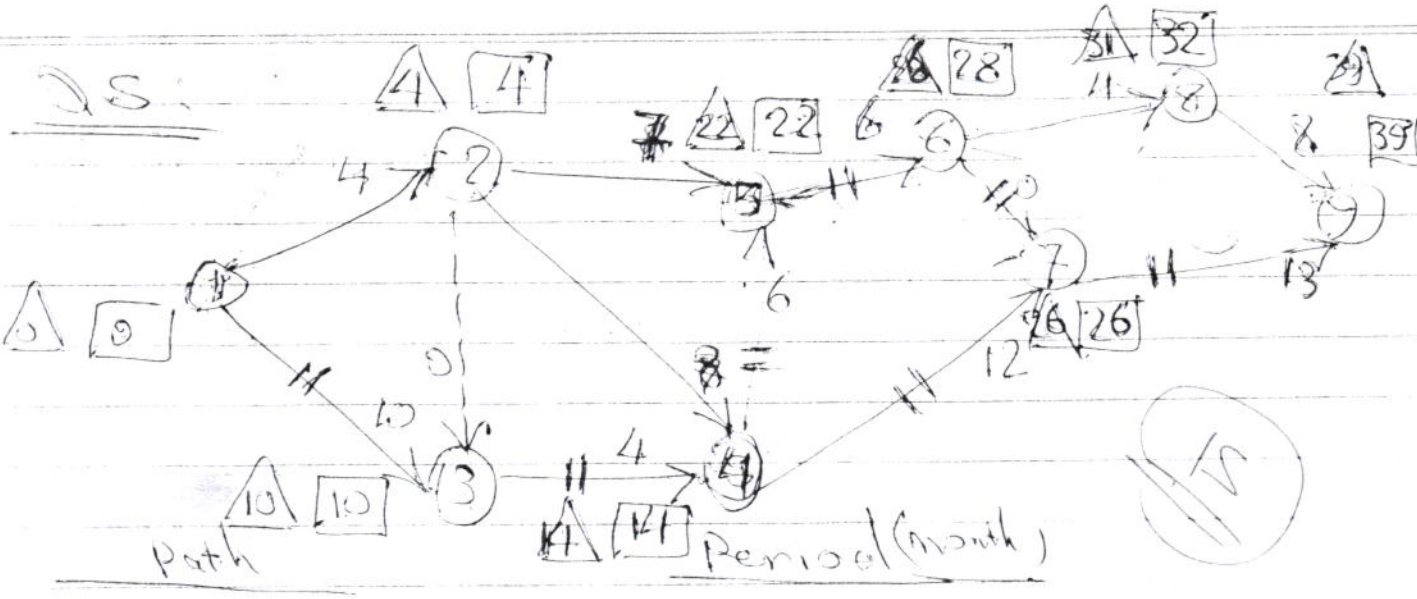
The minimum cost = 100 BID
at Q = 2 from type A

Q-4:

$$C = C_1 + C_2 + C_3$$
$$C = 105 Q_1^{-1.5} + 80 Q_2^{-1.4} + 120 Q_3^{-1.3}$$
$$Q_1 + Q_2 + Q_3 = 100$$
$$C_{min} = 105 Q_1^{-1.5} + 80 Q_2^{-1.4} + 120 Q_3^{-1.3} + \lambda (Q_1 + Q_2 + Q_3 - 100)$$

$$\frac{\partial C}{\partial Q_1} = -157.5 Q_1^{-2.5} + \lambda = 0 \quad (1)$$
$$\frac{\partial C}{\partial Q_2} = -112 Q_2^{-2.4} + \lambda = 0 \quad (2)$$
$$\frac{\partial C}{\partial Q_3} = -156 Q_3^{-2.3} + \lambda = 0 \quad (3)$$
$$\frac{\partial C}{\partial \lambda} = Q_1 + Q_2 + Q_3 - 100 = 0 \quad (4)$$

By solving the above equations
$Q_1 = 35$ m³/sec
$Q_2 = 30$ m³/sec
$Q_3 = 35$ m³/sec
To check $Q_1 + Q_2 + Q_3 = 100$ m³/sec
The costs : $C_1 = 0.5$ BID
$C_2 = 0.7$ BID
$C_3 = 0.99$ BID
$C = 2.19$ BID



Path	Period (month)
1-2-5-6-8-9	29
1-2-5-6-7-9	30
1-2-4-5-6-8-9	32
1-2-4-5-6-7-9	33
1-2-4-7-9	37
1-3-4-5-6-8-9	32
1-3-4-5-6-7-9	33
1-2-3-4-7-9	33
1-3-4-5-6-8-9	38
1-3-4-5-6-7-9	37
1-3-4-7-9	39

The critical paths are
1-3-4-5-6-7-9
and 1-3-4-7-9
and the period is (39) month

Q.6 :- 12 canals L = 59 km

$C = C_1 + C_2 + C_3$

$C_1 = C_1 \cdot V$

$= 100{,}000 \times 0.1 \times r^3$

$C_1 = 10000 r^3$

$C_2 = 10000 \times 0.1 \times r$

$C_2 = 1000 r$

$C_3 = 15000 \times 0.1 \times \frac{1}{r}$

$= \frac{1500}{r}$

$C = 10000 r^3 + 1000 r + \frac{1500}{r}$

$\frac{dc}{dr} = 30000 r^2 + 1000 - \frac{1500}{r^2} = 0$

$r = 0.45$ m

$C = 2036000$ ID/m

Total cost $= 2036000 \times 56000$

$= 1.1 \times 10^{11}$ ID