Benha University
Faculty of Engineering at Shoubra
Civil Engineering Department
Third Year Civil, Structures

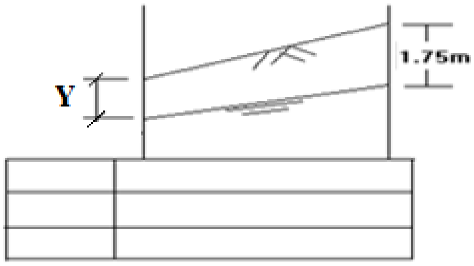
Final 2nd Term Exam
Date: 31 / 5 / 2017
Irrigation & Drainage Engineering
CVS 325
Duration: 3 hours

- Answer all the following questions.
- Illustrate your answers with sketches when necessary.
- The exam consists of 2 pages.
- No. of Questions: 4
- Total Mark: 100 Marks

Question (1) **(15 + 10 = 25 Marks)**

A- *State True or False & Correct the False:*

1) In semi-arid regions, the available rainfall is not sufficient for the plants' growth.
2) The total volume of water in the world is varying due to climate changes.
3) Capillary water is useful for the plant.
4) Excess water in the soil is the moisture above W.P.
5) Two-turn irrigation rotation must be used when cotton is cultivated.



B- *In the figure:*

1) State the type of the ground slope?
2) Fix the required constructions on the figure?
3) What is the minimum value for Y?
4) State the suitable i for the water line?
5) If W.L = (9.00) at Km 0.0, what is the required W.L in the branch?

Question (2) **(25 Marks)**

A branch canal has a length of 15 km, serves an area of 16,500 Feddan, and feeds 3 distributary canals. The land is cultivated as 40% rice and 55% Sharaki. *The data are in the following table:*

Distributary Canal	Location (L: Left)	Area Served (Feddan)	Land Levels for Distributary Canals at Km:				
			0.0	1.0	2.0	3.0	4.0
C 1	2.0, L	5000	(12.00)	(11.95)	(11.90)	(11.80)	(11.70)
C 2	6.0, L	4000	(11.60)	(11.55)	(11.50)/(10.50)	(10.45)	---
C 3	10.0, L	5000	(11.40)	(11.20)	(11.00)	(10.80)	---

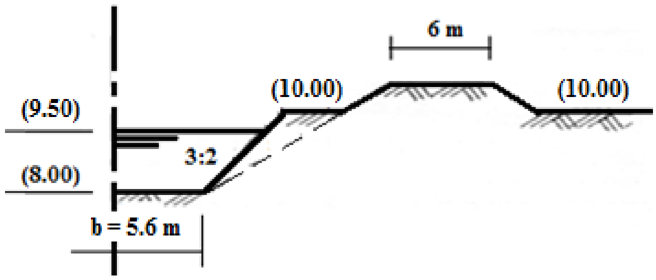
1. For a suitable irrigation rotation, sketch a plan for the branch canal and its distributary canals showing the required constructions?
2. Draw the synoptic diagram ONLY for the distributary canal C1 for lift irrigation?
3. Calculate the area served for design at different sections of the branch canal, (compensation ratio = 20%)?
4. Determine the discharges at different sections of the branch canal, (F.W.D. = 50 m^3/Fed/day)?
5. What is the discharge at km 9.0 of the branch canal?

Question (3) **(9+16 = 25 Marks)**

A- Design the cross section at km 5.0 of a branch drain, (A.S. = 20,000 Feddan, D.F. = 15 m^3/Fed/day, i = 12 cm/km, Z = 1.5 & b = 1.5 y)?

B- The figure shows the cross section at km 3.0 of a branch canal that has a discharge of 13 m^3/s and i = 10 cm/km.

1) At km 9.0 of the branch canal, find the bank level so that cut = fill?
2) Draw a typical cross section of the branch canal at km 9.0?
3) Find the velocity at km 9.0 of the branch canal?
4) Discuss this value of the velocity?



Question (4) **(25 Marks)**

Examiners Board: ***Dr. Alaa El-Hazek, Dr. Mohamed Hassan***

A Model Answer

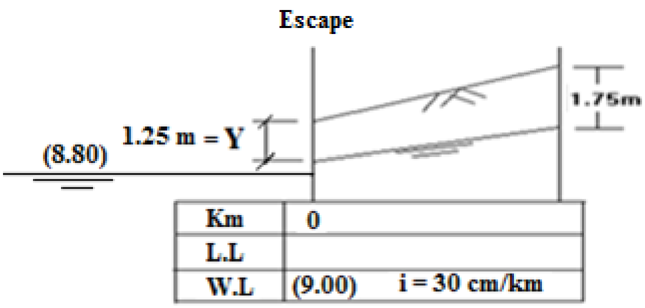
Question (1) (15 + 10 = 25 Marks)

A-

No	The Statement	T / F	Correction
1	In semi-arid regions, the available rainfall is not sufficient for the plants' growth.	T	---
2	The total volume of water in the world is varying due to climate changes.	F	constant
3	Capillary water is useful for the plant.	T	---
4	Excess water in the soil is the moisture above W.P.	F	F.C.
5	Two-turn irrigation rotation must be used when cotton is cultivated.	F	rice

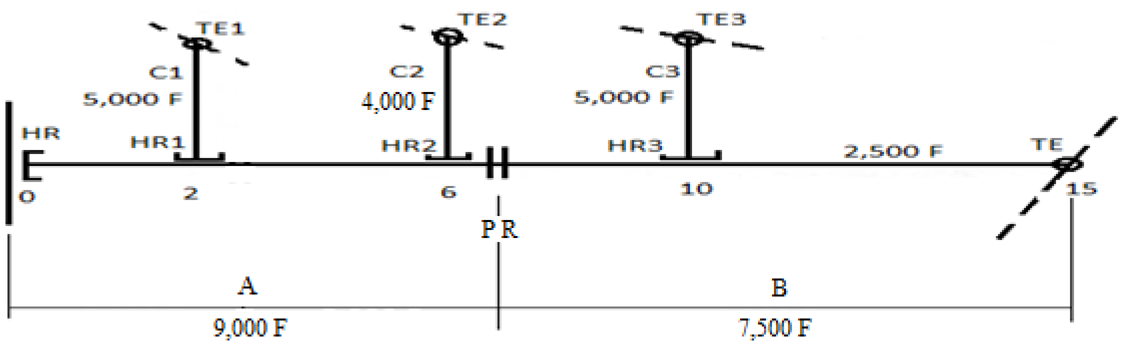
B-

1) The ground has steep slope.
2) The required constructions are shown on the figure.
3) The minimum value for Y is 1.25 m
4) The suitable slope, i = 30 cm/km
5) If W.L = (9.00) at Km 0.0, the required W.L in the branch is (8.80)

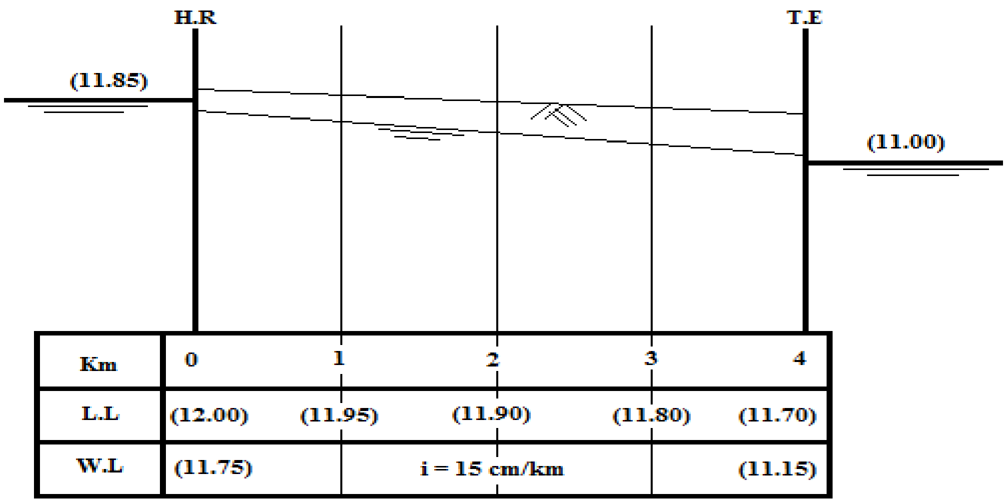


Question (2) (25 Marks)

1. *Two - turn irrigation rotation:*



2. *Synoptic diagram for the distributary canal C1:*



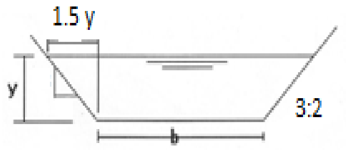
3. & 4. *The area served for design & discharges at different sections of the branch canal:*

Location	**AS, Feddan**		**AS & Compensation, Feddan**		**AS Design, Feddan**	**Discharge, m^3/s**
Km	**Turn A**	**Turn B**	**A+0.2B**	**B+0.2A**		**$Q=AS_{Design}*\frac{(50*1.15)}{24*60*60}$**
2, L	9,000	7,500	10,500	9,300	10,500	7.04
	4,000	7,500	5,500	8,300	8,300	5.56
6, L	4,000	7,500	5,500	8,300	8,300	5.56
	0	7,500	1,500	7,500	7,500	5.03
10, L	0	7,500	1,500	7,500	7,500	5.03
	0	2,500	500	2,500	2,500	1.68

5. *The discharge at km 9.0 of the branch canal:* 5.03 m^3/s

Question (3) **(9+16 = 25 Marks)**

A- *Design the cross section at km 5.0 of a branch drain:*



$Q = A.S. \times D.F. = \frac{20,000 * 15}{24 * 60 * 60}$ $\quad \therefore Q = 3.47\ m^3/sec$

Trapezoidal section, z = 1.5 $\quad \therefore$ z:1 = 3:2

$A = b\,y + [2 * (1/2) * y * 1.5y] = b\,y + 1.5\,y^2$

$\&\ P = b + 2\,(y^2 + 2.25\,y^2)^{1/2} = b + 3.61\,y$

$b = 1.5\,y$

$\therefore A = 1.5\,y^2 + 1.5\,y^2 = 3\,y^2$

$\&\ P = 1.5\,y + 3.61\,y = 5.11\,y$

$\therefore R = \frac{A}{P} = \frac{3\,y^2}{5.11\,y} = 0.587\,y$

$Q = A * v = (1/n) * R^{3/2} * S^{1/2} * A$

$S = i = 12 / 10^{-5}$ $\quad \&$ $\quad 1 / n = 33$

$3.47 = 33*(0.587)^{2/3} * y^{2/3} * (12*10^{-5})^{1/2} * 3\,y^2$

$\therefore y^{8/3} = 4.57$ $\quad \therefore y = 1.77$ m $\quad \therefore b = 2.66$ m

Take $b_m = 2.5$ m

$A_{calculated} = A_m$

$\therefore b\,y + 1.5\,y^2 = b_m\,y_m + 1.5\,y_m^2$

$(2.66*1.77) + 1.5*(1.77)^2 = 2.5\,y_m + 1.5\,y_m^2$

$1.5\,y_m^2 + 2.5\,y_m - 9.41 = 0$

$y_m^2 + 1.67\,y_m - 6.27 = 0$

$y = \frac{-b \pm [(b)^2 - (4*a*c)]^{1/2}}{2*a}$

$\therefore y_m = \frac{-1.67 \pm [(1.67)^2 - (4*1*-6.27)]^{1/2}}{2 \times 1}$ $\quad \therefore y_m = 1.8$ m

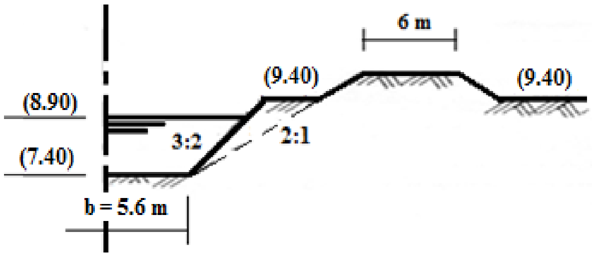
B-

1) At km 9.0 of the branch canal,

The levels are as shown in figure (i = 10 cm/km).

Bank level = Berm level + y

For simplicity, take ½ section as shown in figure.



$A_{Cut} = (2.8*2) + (2*1/2*3) = 8.6\ m^2$

$A_{Fill} = (6*y) + (1/2*2y*y) = 6\ y + y2\ m^2$

$y^2 + 6\ y = 8.6$

$y^2 + 6\ y – 8.6 = 0$

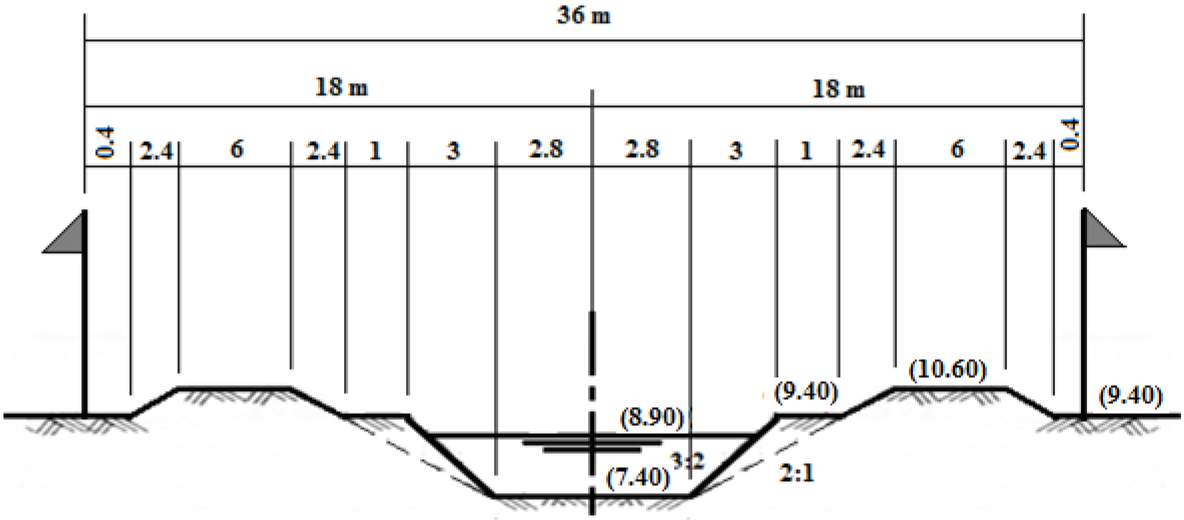
$$y = \frac{- b \pm [(b)^2 - (4*a*c)]^{1/2}}{2*a}$$

$$\therefore\ y = \frac{- 6 \pm [(6)^2 - (4*1*– 8.6)]^{1/2}}{2 \text{ x } 1}$$

$\therefore\ y = 1.2$ m

Bank level = (9.40) + 1.2 = (10.60)

2) *The typical cross section of the branch canal at km 9.0:*



3) $A = (5.6*1.5) + (2*1/2*2.25*1.5) = 11.78\ m^2$

$\therefore\ v = Q / A = 13 / 11.78 = 1.1$ m/s

4) v > 0.9 m/s, So, it will cause scour.

For non-silting non-scouring conditions, $0.3 < v < 0.9$

We have to reduce the velocity by increasing the water area.