THE OPEN UNIVERSITY OF SRI LANKA
Department of Civil Engineering

Bachelor of Technology (Civil) - Level 4
CEX 4233 - Irrigation Engineering

Final Examination - 2015/2016

Time Allowed **3 Hours**

Date: 23rd November 2016 Time 13:30 - 16:30

This paper consists of *Seven* Questions. Answer *Five* Questions **Only**.

All questions carry ***equal*** marks.

Please write answers clearly showing any derivations required and stating necessary assumptions.

ANNEX of Equations *is available at the end of the Question Paper.*

Density of water = 1000 kgm^{-3} Acceleration due to gravity = 9.81 ms^{-2}

1.

a. Explain the difference between Duty and Delta of a crop.

b. Briefly explain ***three*** (3) factors which can affect the Duty of a crop.

c. A stream of 130 litres per second was diverted from a canal and 100 litres per second were delivered to the field. An area of 1.6 hectares was irrigated in 8 hours. The effective depth of root zone was 1.7 m. The runoff loss in the field was 420 m^3. The depth of water penetration varied linearly from 1.7 m at the head end of the field to 1.1 m at the tail end. Available moisture holding capacity of the soil is 20 cm per metre depth of soil.
If the irrigation was started at a moisture extraction level of 50% of the available moisture, Determine;

i) Water conveyance efficiency
ii) Water application efficiency
iii) Water storage efficiency
iv) Water distribution efficiency

contd... on page 2

2.

a. Briefly explain the following terms related to irrigation requirement of crops.

i) Consumptive use
ii) Field capacity
iii) Permanent wilting point

b. What is the difference between Consumptive Irrigation Requirement (CIR) and Net Irrigation Requirement (NIR)?

c. Determine the Field capacity of a soil for the following data.

i) Depth of root zone - 1.8 m
ii) Existing moisture - 8%
iii) Dry density of soil - 1450 kg/m^3
iv) Quantity of water applied to soil - 650 m^3
v) Water lost due to deep percolation and evaporation - 10%
vi) Area to be irrigated - 1000 m^2

3.

a. Discuss *two* (2) advantages and *two* (2) disadvantages of Earth dams and Gravity dams.

b. Explain the difference between Diversion dams and Detention dams.

c. Briefly explain ***three*** (3) factors need to be considered when selecting a site for constructing a dam.

d. Explain the ***three*** (3) types of surveys need to be completed before commencing the construction of a dam.

4.

a. Explain the difference between Perennial and Non-Perennial Canals.

b. Briefly explain ***three*** (3) methods used in alignment of canals.

c. What is meant by lining of canals?

d. Explain ***three*** (3) advantages of lining canals.

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5.

a. Figure 1 shows some important items related to a reservoir. Define and explain items 1, 2, 3, and 4 labelled in the figure.

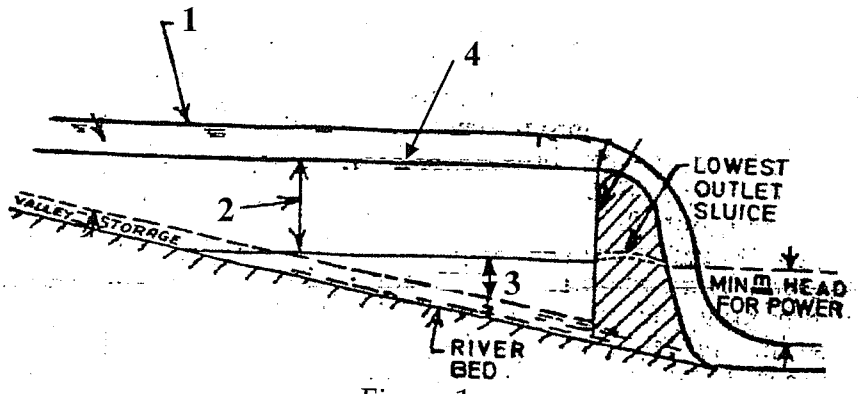

Figure 1

b. Explain how siltation can occur in reservoirs.

c. Briefly explain ***three*** (3) pre-construction measures which can be taken for silting control of reservoirs.

d. Mention ***three*** (3) types of spillways constructed at dam sites.

6.

a. Explain why streamflow measurement is important for irrigation construction works.

b. The following are the data obtained in a stream-gauging operation. A current meter with a calibration equation $V = (0.32N + 0.032)$ m/s, where N = revolutions per second was used to measure the velocity at 0.6 depth. Using the **mid-section method**, calculate the **discharge** in the stream.

Distance from Right bank (m)	0	2	4	6	9	12	15	18	20	22	23	24
Depth (m)	0	0.50	1.10	1.95	2.25	1.85	1.75	1.65	1.50	1.25	0.75	0
Number of revolutions	0	80	83	131	139	121	114	109	92	85	70	0
Observation Time (s)	0	180	120	120	120	120	120	120	120	120	150	0

Table 1

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7.

a. Briefly explain the importance of hydrometric measurements for irrigation.

b. Explain the difference between the following methods related to determination of mean precipitation over an area.

i) Arithmetical-mean method
ii) Thiessen-polygon method

c. Four rain gauge stations are located in a catchment, whose shape can be approximated by a pentagon. The coordinates of the corners of the catchment that define its boundaries and the coordinates of the four rainguage stations are given below. Also given are the annual rainfall recorded by the four stations in the year 2015. Determine the average annual rainfall over the catchment in 2015 by Thiessen-polygon method.
Distances are in km. Corner *a* is the origin of coordinates.

Catchment boundary	Corner	*a*	*b*	*c*	*d*	*e*
	Coordinates	(0,0)	(120,0)	(120,80)	(60,140)	(0,80)
Rain gauge Station	Station	P	Q	R	S	
	Coordinates	(40,20)	(80, 20)	(80,60)	(40,60)	
	Annual Rainfall (cm)	120	110	100	125	

Table 2

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ANNEX of Equations

- Efficiency of water-conveyance

$$\eta_c = \frac{water\ delivered\ to\ the\ fields\ from\ outlet\ of\ channel}{water\ pumped\ to\ the\ channel\ at\ the\ starting\ point}$$

- Efficiency of water-application

$$\eta_a = \frac{quantity\ of\ water\ stored\ in\ root\ zone\ of\ crops}{quantity\ of\ water\ actually\ delivered\ in\ to\ the\ field}$$

- Efficiency of water-storage

$$\eta_s = \frac{water\ stored\ in\ root\ zone\ during\ irrigation}{water\ needed\ in\ the\ root\ zone\ prior\ to\ irrigation}$$

- Efficiency of water use

$$\eta_u = \frac{water\ beneficially\ used}{quantity\ of\ water\ delivered}$$

- Efficiency of water distribution

$\eta_d = 1 - \frac{d}{D}$ where;

D = mean depth of water stored during irrigation
d = avg. of the absolute values of deviations from the mean

- Total water storage capacity of soil = $\gamma dF/\omega$ meters where;

γ –density of soil, d – metre depth of root zone, F – Field capacity, and
ω – density of water

- End of Question Paper -