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THE OPEN UNIVERSITY OF SRI LANKA
Department of Civil Engineering

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

Final Examination - 2016/2017

Time Allowed **3 Hours**

Date: 15th November 2017 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.**

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

1.

a. Explain the difference between **Crop period** and **Base period** a crop.

b. Derive the relationship between **Delta (Δ)** and **Duty (D)** of a crop.

c. A stream of 150 litres per second was diverted from a canal and, out of that 120 litres per second were delivered to the field. An area of 1.8 hectares was irrigated in 8 hours. The effective depth of root zone was 1.6 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 22 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) Soil moisture deficiency
ii) Readily available moisture
iii) Optimum moisture content

b. What is the difference between **Capillary water** and **Hygroscopic water?**

c. Rice is to be grown in a field having a field capacity equal to 27% and the permanent wilting point is 13%.

i) Find the storage capacity in 80 cm depth of soil, if the dry unit weight of the soil is 1.5 $gcm^{-3}$.
ii) If irrigation water is to be supplied when the average soil moisture falls to 18%, find the water depth required to be supplied to the field when the field application efficiency is 80%.
iii) What is the amount of water needed at the canal outlet, if the water loss in the water courses and the field channels is 15% of the outlet discharge.

3.

a. Discuss *two* (2) advantages and *two* (2) disadvantages of **Steel dams** and **Arch dams**.

b. Name and Explain the types of dams classified based on **Hydraulic design**.

c. Briefly explain *three* (3) factors governing the selection of **type of dam.**

d. Explain the difference between **Storage dams** and **Detention dams.**

4.

a. Explain the difference between **Alluvial** and **Non- Alluvial** Canals.

b. Briefly explain how canals are aligned as **Watershed canals**.

c. Mention *five* (5) important factors need to be considered in canal alignment.

d. Explain how **Water logging** can be prevented by lining of canals.

*contd... on page 3*

5.

a. Explain the difference between **Reservoir yield** and **Safe yield** related to reservoirs in Irrigation Engineering.

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

c. Explain the purpose of **Spillways** in reservoirs.

d. Explain the difference between **Ogee spillway** and **Side channel spillway**.

6.

a. Explain the basic requirements for **Area-velocity method** to be used for streamflow measurement.

b. The following are the data obtained in a stream-gauging operation. A current meter with a calibration equation $V = (0.42N + 0.042)$ 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 Left bank (m) | 0 | 2 | 4 | 6 | 9 | 12 | 15 | 18 | 20 |
|---|---|---|---|---|---|---|---|---|---|
| Depth (m) | 0 | 0.70 | 1.20 | 1.75 | 2.35 | 1.85 | 1.35 | 0.65 | 0 |
| Number of revolutions | 0 | 80 | 93 | 121 | 140 | 131 | 108 | 70 | 0 |
| Duration of Observation (s) | 0 | 160 | 110 | 110 | 110 | 110 | 110 | 110 | 0 |

Table 1

7.

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

b. Explain the difference between the following methods related to presentation of rainfall data.

i) Mass curve of rainfall data
ii) Hyetograph

*contd... on page 4*

c. Six rain gauge stations are located in and around a catchment as shown in Figure 1. Recorded rainfall data is available for August 2017 in all stations and it is required to determine the average rainfall using Thiessen-polygon method. The relevant Thiessen polygon areas related to each station is given in Table 2. Determine the average monthly rainfall over the catchment in August 2017.

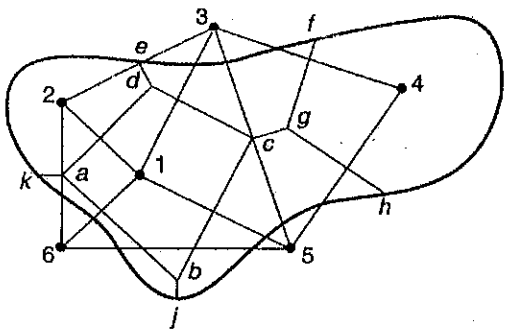


Figure 1

| Raingauge Station | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Thiessen Polygon Area ($km^2$) | 720 | 380 | 440 | 1040 | 800 | 220 |
| Recorded Rainfall in August 2017 (mm) | 121 | 134 | 145 | 126 | 99 | 115 |

Table 2

- End of Question Paper -