THE OPEN UNIVERSITY OF SRI LANKA
Diploma in Technology (Civil) - Level 4
CEX 4233 - Irrigation Engineering
Final Examination - 2008

Date : 08th May 2008
Time : 9:30 - 12:30 hrs
Duration : Three (03) hours

Answer any five (05) questions. All questions carry equal marks.

1.

The Kotmale project encompasses the construction of a 87 m (285 ft.) high rock fill dam with a concrete membrane across the Kotmale Oya, an important right bank tributary in the upper reaches of the Mahaweli ganga about 25 miles upstream of the Polgolla barrage.

a. Discuss briefly the reasons for locating the dam at the selected location.
b. Discuss why a rock fill dam was selected for the location. Why not a gravity dam?
c. The Kotmale area has had a history of earthslips, landslips, and other geological disturbances. Owing to this, great care had to be taken in the design of the various features of the project. Discuss about the subsurface explorations that must have taken place in and around the proposed location of the dam.
d. Explain why earth-rock fill dams are increasingly adopted in preference to other types of dams.
e. What are the various causes of failure of above type of dams? Draw sketches to illustrate.

2.

Sri Lanka has a remarkable heritage of ancient irrigation works which eloquently testify to the highly sophisticated level of hydraulic engineering practiced by the early craftsmen. Some of these works date back to the 3rd century BC. Most of them are so advanced in design and execution that they have endured to the present day

with very little renovation.

a. Rehabilitation of existing irrigation schemes is of vital importance. Discuss the benefits of rehabilitation work.
b. Taking examples from the hydraulic structures that have survived to this day, discuss about the high achievements in irrigation management and technology of our ancient engineers.
c. At some point in the history, the capital of Sinhalese kingdom was shifted from dry zone to wet zone. With this shifting of the capital the irrigation system was neglected and gradually went into ruins. Discuss the possible causes for this situation.
d. Ancient irrigation systems were constructed to provide free access of water to humans and animals. Discuss on the ancient water management procedures.
e. In recent times it has become a great problem to provide adequate water for dry zone farmers. But it was the same areas that had sustained a majority of farming communities in the past. Discuss the reasons behind the success of our ancient tank builders.

3.

a. Explain what you mean by the consumptive use of water. Discuss about the factors that affect the consumptive use of water.
b. Work out the irrigation schedule based on the soil moisture content, given the following information.

- The crop is grown in an appropriate soil with no restrictive layers within the top 1.5 m depth of soil.
- Normal root zone depth of the crop is 1.2 m.
- Bulk density of soil is 1.35.
- Field capacity is 18% and permanent wilting point is 7%.
- Moisture level in the soil is to be maintained at not less than one third of available retention. Irrigation will then be done over a duration of 2 days at a uniform rate just to compensate for the depletion.
- No extra water is required for leaching.
- Sowing is done on 1st November when the soil moisture is left just at field capacity in the entire root zone.
- For the crop, at the location, the average evapotranspiration rates are
  - 1st November - 30th November : 1.1 mm/day
  - 1st December – 31st December : 1.7 mm/day

- 1st January – 31st January : 2.4 mm/day
- 1st February – 28th February : 1.5 mm/day
- 1st March – 25th March : 3.5 mm/day

- Harvesting is done on or after 26th March.
- Effective rainfall of 24 mm is expected during 4th January to 19th January, both days inclusive with uniform intensity.
- By the end of the crop growth season, only the minimum water needed to be left unused in the root zone.

Determine,

i. The total depth of irrigation water required.
ii. The respective dates of irrigation and water supply.

4.

a. An irrigation canal is aligned in such a way that the water gets proper command over the whole irrigable area. Briefly explain the procedure involved in aligning a canal.
b. In a hilly area, where watershed line is very high as compared to head works, state the type of alignment that you would recommend for a proposed canal, if cross drainage is to be avoided. Explain your answer.
c. How will you justify economically the necessity for lining an existing canal. State the added benefits that you will expect if the canal to be lined is new and yet to be constructed.
d. An area of 40,000 hectares has to be irrigated by a canal for growing rice; water requirement for which is 10 cm per month. Design and draw a suitable canal section with the data given below:
    - Mean slope of the ground = 1 in 3400
    - Side slopes = 1:1
    - Manning's roughness coefficient N= 0.025
    - Try a depth equal to 2m.

5.

a. Discuss the various problems, which are posed by the irrigation canals during their use and the appropriate remedial measures.
b. What is a canal drop? Why is it necessary to provide a drop?
c. What are the different methods of passing a canal across a drain? Explain the necessity of providing cross drainage work.

d. Why is it necessary to control silt entry in the canal. What methods are adopted for the above purpose?

e. Do you think it is necessary to charge for the water supplied for irrigation? State the principles that you will set the irrigation rates on. How will this affect the general economy?

6.

a. Describe various methods of irrigation and enumerate their advantages and disadvantages.

b. What are the possible causes of water losses in distribution of irrigation water? Explain briefly the methods adopted in reducing such losses.

c. What are the factors affecting irrigation water requirement of a crop?

d. The base period, duty of water and area to be cultivated for various crops under a canal system are given in table (1). Determine the reservoir capacity if the canal losses are 25% and reservoir losses are 15%.

Table (1)

Crop	Base period(days)	Duty of water at the field (hec/cumec)	Area to be cultivated (hectares)
Wheat	120	1800	8000
Sugarcane	360	1700	8000
Cotton	180	1400	4000
Rice	120	800	6000
Vegetables	120	700	6000

7.

Provide answers to any three of the following;

a. Give the types of dams which could be selected for the following sites. Justify with reasons.

i. A wide gorge with good foundations.

ii. A narrow deep gorge with strong abutments.

iii. A gorge with weak foundations but with abundant availability of material locally.

iv. A gorge in hilly terrain with poor access.

b. "Technically badly done, economically dubious, and environmentally an

insult" was the comment made by one of the environmentalist about the Upper Kotmale Hydropower Project. Discuss the above comment critically giving advantages and disadvantages of the project.

c. Operation studies are done to obtain better estimates of reservoir capacities. Explain how you carryout an operation study to determine a reservoir capacity.

d. Diversion structures in the form of weirs, barrages or anicuts across natural rivers are used to head up water so that the water can be diverted through a different course or canal. Write short notes on the above mentioned structures, giving examples from Sri Lanka.

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