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THE OPEN UNIVERSITY OF SRI LANKA
Diploma in Technology (Civil) – Level 4
CEX 4233 – Irrigation Engineering
Final Examination – 2009/2010
Duration : Three (03) hours

Index Number.....

Date: 23rd March 2010 Time: 14:00-17:00 hrs.

PART A:

Underline the most appropriate answer in each question.
Answer all questions.
Each question carries 3 marks and the mark for Part A makes up 30% of the total mark.
Part A should be detached from the question paper and attached to the answer script.

1. In a hilly area, where watershed line is very high compared to the head works, which type of alignment would you recommend for a proposed canal, if cross drainage is to be avoided:
   (a) canal along the ridge line.
   (b) canal along the contour line.
   (c) canal across the contour lines.
   (d) none of the above.
2. Irrigation water is usually applied to the fields when the available moisture in the root zone of the crop gets depleted by;
   (a) 0 – 10%
   (b) 10 – 25%
   (c) 50 – 80%
   (d) 100%
3. Which of the pairs are correctly matched?
   1. Device to receive and eject drainage from canal - Inlet and outlet
   2. Cross drainage structure when canal bed level and drain bed level are same - Canal siphon
   3. Cross masonry work to facilitate road transport - Bridge

   (a) 1, 2 and 3
   (b) 1 and 3
   (c) 2 and 3
   (d) 1 and 2

4. The canal which can irrigate only on one side is a:
   (a) watershed canal
   (b) contour canal
   (c) side slope canal
   (d) none of them
5. The free board in lined canals is measured between:
   (a) FSL and top of lining
   (b) FSL and top of tunnel bank
   (c) top of lining and top of canal bank
   (d) none of the above.
6. In a concrete gravity dam with a vertical upstream face, the stabilizing force is provided by the :
   (a) weight of the dam
   (b) the water supported against the upstream slope
   (c) both (a) and (b)
   (d) none of the above
7. The correct statement with reference to earthen dams is:
   (a) these are very costly as compared to other types
   (b) they are less susceptible to failure as compared to rigid dams
   (c) they can be constructed almost on every type of foundation
   (d) highly skilled labour is generally not required
8. When seepage takes place through the body of an earthen dam, it leads to:
   (a) development of pore pressures in the dam body
   (b) reduction in the shear strength of the dam
   (c) (a) only
   (d) both (a) and (b)
9. The safety valve of a dam is its:
   (a) drainage gallery
   (b) inspection gallery
   (c) spillway
   (d) outlet sluices
10. An arch dam behaves as:
   (a) a cantilever vertical retaining wall, standing up from its base
   (b) an arch, transferring loads at the two ends by horizontal arch action
   (c) both (a) and (b)
   (d) none of the above

PART B:

Answer any four (4) questions. Each question carries 17.5 marks and the mark for part B makes up 70% of the total mark.

1.

a. Crop rotation has been known to the farmer since early ages. Explain why crop rotation is adopted.

b. Explain the terms duty, delta and base period in connection with irrigation. Establish a relation between duty of water, delta and base period.

c. The food production of Sri Lanka has increased due to the adoption of appropriate cropping patterns and modern technologies. Discuss critically.

d. A water course commands an irrigated area of 1000 hectares. The intensity of irrigation of rice in this area is 70%. The transplantation of rice crop takes 15 days and during the transplantation period, the total depth of water required by the crop on the field is 500 mm. During the transplantation period, the useful rain falling on the field is 120 mm. Find the duty of irrigation water for the crop on the field during transplantation

   i) at the head of the field.

   ii) at the head of water course (assume losses of water to be 20% in the water course.

2.

a. Lands are said to be arable if they can be prepared for agriculture and if they can give a sufficient yield to justify its development. Discuss about the factors that should be considered before selecting suitable land for agriculture?

b. There are various methods in applying irrigation water to the fields for irrigation purposes. Briefly explain why different methods are adopted and state three (3) of them. Give 2 merits and demerits of each.

c. Explain what you mean by the consumptive use of water. Discuss about the factors that affect the consumptive use of water.

d. Given the following information, calculate;

   i. the crop water requirement for initial and development periods.

   ii. the crop water requirement for the whole season.

Growth stage	Initial	Development	Mid	Late
Growth period (days)	25	25	75	25
Crop factor	0.65	0.85	1.0	0.9

The following data are also given;

Month ⟶	April	May	June	July	August
ET_0 mm/day	5.0	5.24	5.84	6.14	6.23

ET_0 – Reference crop evapotranspiration

Soil is brought to field capacity on 1st April 2006.

3. Samanalawewa reservoir, formed by a 100m high rockfill dam is one of the largest reservoirs built in Sri Lanka in the recent times. Signs of possible leakage through the right bank appeared even during construction of the dam. A number of remediation methods were adopted, but the leakage could not be stopped. The reservoir is presently operating with a continuous leakage of 1800 litres per second.
   a. Checking the water tightness of a reservoir is of prime importance when investigating for a good design of the foundations of reservoirs. Discuss about the possible causes that would have led to the leakeage of Samanalawewa reservoir.
   b. Suggest remedies to control/ prevent such leakages.
   c. Samanalawewa dam is 110 metres in height and has a length of 530 metres at crest level. The dam is of rock fill, central earth core type.
      i. What are the considerations that you will make in selecting the best type of dam for a particular location?
      ii. Explain why earth-rockfill dams are increasingly adopted in preference to other types of dams.
      iii. Draw a typical cross section of a rockfill dam.
   d. Due to the Samanalawewa hydropower project, the people who were resettled suffered economic and social hardship. The project displaced some 30,000 people, flooding 28 square kilometers of the productive and densely populated Dumbara valley. Discuss the socio-economic impacts on the people who were resettled due to Samanalawewa project.

4. Diversion structures in the form of weirs, barrages or anicuts across natural rivers are used to head up water so that the river can be diverted through a different course or canal.
   a. Briefly explain the steps that you follow in diverting water from a river to a canal.
   b. Discuss about the uses in constructing an obstruction or a barrier across a river.
   c. Give 3 examples of weirs, barrages or anicuts constructed in Sri Lanka.
   d. Why is a barrage preferred to a weir in modern days?
   e. What are the important considerations that must be made in selecting a suitable site for a weir?

f. Many weirs constructed on pervious foundations failed in the course of time. What are the main causes of failure of weirs on pervious foundations?

g. Discuss about the remedies that you would suggest in preventing the causes of failure that you suggested in (g).

h. Explain how a hydraulic jump helps in dissipating the energy of water falling over a weir.

5.

a. A reservoir bed survey carried out for the feasibility study of a proposed dam yielded the following data(Table Q5).

Table Q5

Elevation (m)	Area (ha)	Cost of construction (Million Rupees)	Present value of income (Million Rupees)
240	0	0.5	-
250	61.5	3.1	3.6
260	122.6	4.8	5.1
270	165.8	5.4	6.8
280	200.7	6.7	6.6
290	225.8	6.8	6.5
300	241.6	7.0	6.4

i. Calculate the reservoir capacity at various dam elevations.

ii. Find the most economical height of the dam.

b. Provide answers to the following;

i. "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.

ii. 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.

iii. 'No people in any age or country had so great practice and experience in the construction of irrigation works'. The above statement made by the British in 19th century, well elaborates the constructive achievement of the ancient Sinhalese. Giving examples justify the above statement.

6.

a. Irrigation canals are nothing but earthwork constructions and as such very much susceptible to damage. They therefore require a lot of maintenance, upkeep, watch and ward so as to ensure their continuous efficient functioning.

   i. Discuss various problems, which are posed by the irrigation canals during their use.

   ii. Give appropriate remedial measures to the problems mentioned in (i).

b. The conveyance system joining two reservoirs consists of a lined canal 2.4 km long followed by a free flow lined tunnel of 4.8 km long. The discharge required in the conveyance system is 28 m^3s^{-1}. The canal has a bed width of 3m, side slopes 1(V) to 1.5 (H) and a depth of flow of 3m. The hydraulic radius and area of flow in the tunnel are 1.3 m and 13.0 m^2 respectively. Determine the friction slopes in the canal and the tunnel. Take Manning's n for the lined canal as 0.015 and for the lined tunnel as 0.013.

c. An existing unlined canal has the following dimensions;

Bed width	= 2 m
Side slopes	= 1 vertical to 1 horizontal
Depth of flow	= 1.0 m
Bed slope	= 0.0002
Manning's coefficient	= 0.02

Determine the discharge of the canal and comment if the canal would silt or scour.

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