THE OPEN UNIVERSITY OF SRI LANKA
Diploma in Technology (Civil) – Level 4
CEX 4233 – Irrigation Engineering
Final Examination – 2011/2012
Duration : Three (03) hours

Index Number.....

Date: 13th March 2012 Time: 14:00-17:00 hrs.

ANSWER ALL QUESTIONS IN PART A AND ANY FOUR QUESTIONS IN PART B.

PART A:

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

1. Yield of a reservoir represents;
   (a) the inflow into the reservoir
   (b) the capacity of the reservoir
   (c) the outflow demand on the reservoir
   (d) none of the above
2. An irrigation canal flowing under pressure below a drainage channel is called a
   (a) Canal aqueduct
   (b) Siphon aqueduct
   (c) Super passage
   (d) Canal syphon
3. The provision of a drainage gallery in a gravity dam helps in reducing
   (a) hydrostatic pressure
   (b) silt pressure
   (c) seepage pressure
   (d) none of the above
4. The pore pressure distribution under steady condition in an earth dam is;
   (a) determined by considering linear variation from upstream to downstream water levels
   (b) determined from the flownet
   (c) the same as the upstream water level
   (d) none of the above.

5. Tension cracks in gravity dams may sometimes lead to the failure of structure by:
   (a) sliding of the dam at the cracked section
   (b) overturning about the toe
   (c) crushing of concrete starting from the toe
   (d) none of the above
6. 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
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. In a concrete gravity dam, with a sloping upstream face, the resisting force is provided by the;
   (a) weight of the dam
   (b) weight of the water supported on the upstream slope
   (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 marks for part B makes up 70% of the total marks.

1.

a. When a natural drain crosses or intercepts an irrigation canal it becomes necessary to construct 'cross drainage works'. Discuss about the various types of cross drainage works in Sri Lanka.

b. Sri Lanka has a unique distinction in the history of mankind of having developed a hydraulic civilization even before the beginning of the Christian era.

   i) 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.

   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.

c. 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 failure of Samanalawewa reservoir.

2.

a. Draw a typical cross section of an earth dam and explain the functions performed by each component briefly.

b. Explain the various seepage control measures undertaken in earth dams.

c. What are the various causes of failure of earth dams? Draw sketches to illustrate the answers.

d. Explain briefly the measures that you will take to prevent the failures mentioned in (c).

e. Rip rap is a layer of large and durable rock fragments placed on the upstream slope of an earth dam. Explain why Rip rap is placed on the upstream slope of the dam?

f. About 40% of the dam failures in the world have been due to foundation failure. In what aspects should you investigate for a good design of the foundation of dams and reservoirs?

3.

There are several advantages in lining the channels. Describe four (4) advantages in lining.

b. 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.

c. i) An existing unlined channel is having the following dimensions:

Width of the bottom = 1.8 m

Side slopes = 1 vertical to 1 horizontal

Depth of flow = 0.4 m

Bed slope = 0.004

(assume the Manning's coefficient = 0.025)

Determine the velocity of flow and check whether it lies in the non - silting, non - scouring range. Also determine the discharge in the channel.

ii) It is proposed to line the above channel for the same discharging capacity (Manning' s coefficient = 0.014)

What percentage of earthwork is saved in a lined section relative to the unlined section?

(The free board can be assumed to be 0.75m in both cases and the lining can be assumed up to the top of the section)

4.

a. Enumerate the different methods, which are used for measuring discharges in open channels or rivers. Discuss anyone of the above methods in detail.

b. You have been asked to measure the discharge of

i) a river

ii) a small stream

iii) a canal.

Discuss briefly how you are going to do it.

c. The following data (Table Q5) is observed on a stream in a standard current meter test.

Table Q5

Distance from right bank (m)	0	2.0	4.0	6.0	9.0	12.0	15.0	18.0	20.0	22.0	23.0	24.0
Depth (m)	0	0.5	1.10	1.95	2.25	1.85	1.75	1.65	1.50	1.25	0.75	0
No.of revolutions at 0.6depth	0	80	83	131	139	121	114	109	92	85	70	0
Time (s)	0	180	120	120	120	120	120	120	120	120	120	0

The rating equation of the current meter is $V=0.32N+0.032$ m/s. Where N is revolutions/sec. Calculate the discharge of the stream.

5.

a. A reservoir bed survey is a must in selecting a suitable location for a dam site. Briefly explain why and how it is done.

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

Table Q5

Contour elevation (m) above datum	Area/(ha)	Cost of construction (Rs. millions)	Present value of benefits of the dam (Rs. millions)
140	0	0.5	-
150	71.2	2.1	2.6
160	141.5	3.8	4.1
170	197	4.4	5.8
180	300	5.7	5.6
190	372	5.8	5.5
200	408	5.9	5.4

Calculate the capacity of the reservoir at various elevations and determine the most economic height of the dam to be constructed here.

6.

a. Explain the steps that you will take in improving the duty of water.

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. A plot of land requires 10mm of water per day for 5 days for soaking. It then requires 20 mm of water per day for the next 3 days for tilling, puddling and leveling. Thereafter it requires 15 mm of water per day for the next 6 days for sowing. Transpiration from sowing to harvest is estimated at 450 mm and evaporation for the same period is estimated at 150 mm. If percolation and seepage etc. is estimated at 150 mm in total,

i) Calculate the total water requirement for this plot of land.

ii) If the effective rainfall is 5 mm per day for 80 days, calculate the field irrigation requirement.

iii) If the earth field canal system losses are estimated at 20%, determine the water requirement at the head of the sluice.

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