THE OPEN UNIVERSITY OF SRI LANKA
Department of Civil Engineering
Diploma in Technology (Civil) – Level 4
CEX 4233 – IRRIGATION ENGINEERING
Final Examination 2010/2011
Duration : Three Hours

Index Number.....

Date: 22nd March, 2011 **Time: 14:00-17:00 hrs**

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

PART A

Answer all questions.

Underline the most appropriate answer in each question.

Part A should be detached from the question paper and attached to the answer script.

1. The outlet provided in a dam body to release water for down stream water demand, is known as
   (a) spillway
   (b) sluice gate
   (c) under-sluice
   (d) waterway
2. The 'dead storage' in a dam reservoir is the available volume for collection of silt and sediment between ;
   (a) bed level of the reservoir and minimum reservoir level
   (b) bed level of the reservoir and the silt level in the reservoir
   (c) bed level of the reservoir and normal pool level
   (d) none of the above
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 relationship between the duty D in ha/cumecs, the water depth Δ in cm, and base period B in days is given by;

   (a) $D = \frac{864B}{\Delta}$

   (b) $D = \frac{8.64B}{\Delta}$

   (c) $D = \frac{864\Delta}{B}$

   (d) $D = \frac{8.64\Delta}{B}$

5. Water conveyance efficiency does not depend upon;
   (a) Climatic conditions
   (b) Geometry of the conveyance system
   (c) Nature of the boundary of the conveyance system
   (d) Method of application of water

6. 'Economical height of a dam' is the height for which the;
   (a) cost per unit storage is minimum
   (b) benefit cost ratio is maximum
   (c) Net benefits are maximum
   (d) none of the above

7. 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

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. Coordination between field and design engineers to ensure continuous field observations and modifications in design during construction, is more important in the case of
   (a) concrete gravity dam
   (b) masonry gravity dam
   (c) arch dam
   (d) earthen dam

10. 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 across the contour lines.
   (b) canal along the contour line.
   (d) none of the above.

PART B:

Answer any four (4) questions.

1.

a. A common example of a diversion dam in Sri Lanka is the Polgolla barrage. Briefly explain what a diversion dam is. State the differences between a diversion dam and a storage dam.

b. Gravity dams and rockfill dams are not suitable for clay foundations. Explain why.

c. 'The ancient reservoirs were built using earth dams and even today they still continue to serve well'. The above statement well elaborates the constructive achievement of the ancient Sinhalese. Explain why the ancient people selected earth dams and how they were built, giving examples from history.

d. The choice of a particular type of dam is generally governed by several factors. Discuss these factors that will help you to assess which dam is best suited.

2.

a. 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

(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)

3.

The Kotmale project envisages the construction of a 87 m (285 ft.) high Rockfill 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. What preliminary investigations are necessary for selecting a site for a dam?
c. Discuss why a rockfill dam was selected for the location.
d. 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.
e. Explain why earth-rock fill dams are increasingly adopted in preference to other types of dams.
f. What are the various causes of failure of above type of dams? Draw sketches to illustrate.

4.

a. Experiments have shown that productivity of water can be doubled, if a scientific water management technique is adopted. As an irrigation engineer, briefly explain your approach in achieving 'scientific water management'.
b. There are various methods in applying irrigation water to the fields for irrigation purposes. Briefly explain why different methods are adopted and discuss three (3) of them.
c. The following table (Table Q4) gives the components of the water requirement for a paddy crop in Yala and Maha.

Table Q4

	Maha (mm)	Yala (mm)
Land soaking	100	175
Standing water from sowing to heading	55	75
Transpiration and evaporation from sowing to harvest	500	575

If the effective rainfall for Maha and Yala are 475mm and 280mm respectively, and the seepage losses account for 200mm for each season;

i. Determine the field irrigation requirements for Maha and Yala.

ii. If the canal losses are 30%, determine the duty at the head sluice.

5.

a. Explain what is meant by stream gauging. Briefly describe the velocity area method that is used for stream gauging.

b. The following measurement data (Table Q5b) were observed in a stream with a standard current meter test.

Table Q5b

Distance from right bank (m)	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5
Depth (m)	0	0.4	1.3	2.2	2.6	2.3	1.7	1.4	1.25	0.75	0.45	0
Velocity (m/sec) at 0.2d	0	0.41	0.56	0.75	0.86	0.81	0.75	0.63	0.59	0.54	0.45	0
Velocity (m/sec) at 0.8d	0	0.20	0.36	0.55	0.61	0.30	0.51	0.42	0.39	0.33	0.25	0

Calculate the discharge of the stream.

6.

a. List the topographical surveys that are necessary when drawing plans to build a reservoir.

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

c. The capacity - elevation data of a proposed reservoir is given in table Q6.

Table Q6

Elevation (m)	Area (ha)	Cost of construction (Million Rupees)	Present value of income (Million Rupees)
100	0	0.5	-
110	140	4	5
120	320	5	6.2
130	615	6	8.4
140	960	7	8.5
150	1325	8	8.6

i. Calculate the reservoir capacity at various dam elevations

ii. Find the most economical height of the dam.

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