THE OPEN UNIVERSITY OF SRI LANKA
Bachelor of Technology (Civil) - Level 4
CEX 4233 - Irrigation Engineering
Final Examination - 2014/2015

Date : 24th August 2015
Time : 13:30 - 16:30 hrs
Duration : Three (03) hours

Answer any five (5) questions. All questions carry equal marks.

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1. The Deduru Oya reservoir, formed by a 2400 m long earthen dam serves the lands in dry and intermediate zones of Kurunegala and Puttalam districts, where the people are frequently suffering from water scarcity.
   a. Discuss the advantages and disadvantages of constructing an earth dam.
   b. Enumerate and explain with neat sketches the different ways by which the earthen dams may fail.
   c. What precautions and remedial measures would you undertake to control seepage through -
      i) the earthen dam body.
      ii) the dam foundation.
   d. 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.

2.
   a. Enumerate on different types of canals in an irrigation scheme and their uses.
   b. What are the possible causes of water losses in a canal? What are the methods adopted in reducing such losses?
   c. Capacity of an irrigation canal is the quantity of water that a canal is designed to carry in a unit time. What are the important considerations that must be taken into account in determining the design capacity of a canal?
   d. 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

i) Determine the velocity of flow and check whether it lies in the non – silting, non – scouring range.

ii) Calculate the discharge in the channel.

3.

a. Write short notes on

i) Optimum utilization of irrigation water

ii) Crop rotation

iii) Consumptive use and its estimation

iv) Net irrigation requirement

b. Monthly water requirement of various crops to be grown in area A is shown in table Q3. A reservoir is proposed to be constructed to command an area equal to 120,000 hectares. The various crops are; paddy, groundnut, maize, Green gram, sugarcane and chillies. The areas under irrigation of these crops are going to be; 20%, 5%, 5%, 10%, 10% and 3% of command respectively. Determine the annual storage required for the reservoir, assuming canal losses as 25% of head discharge, and reservoir evaporation and dead storage losses as 20% of gross capacity.

Table Q3

Month (1)	Field irrigation requirement in cm (FIR)					
	Paddy (2)	Groundnut (3)	Maize (4)	Green gram (5)	Sugarcane (6)	Chillies (7)
June 1-30	19.3				25.9	
July 1-31	6.0				7.6	
Aug. 1-31	7.4				6.8	
Sept. 1-30	7.9				6.0	1.7
Oct. 1-31	29.9		3.4	4.0	34.7	23.5
Nov. 1-30	20.7	6.3	15.1	8.0	42.3	22.4
Dec. 1-31		16.2	23.8	20.6	18.0	16.6
Jan. 1-31		21.6	20.5	22.8	22.0	10.8
Feb. 1-28		13.4		14.3	25.0	
March 1-31					36.5	
April 1-30					40.8	
May 1-31					50.0	

4.

a. List 5 factors that govern the selection of the type of dam for a particular location, and briefly explain any two of them.

b. Give the types of dams which could be selected for the following sites. Justify your answer 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 materials locally.

iv) A gorge in hilly terrain with poor access.

c. Explain in detail the various forces causing instability in a gravity dam.

d. Most 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 a dam?

5.

a. You have been asked to measure the discharge of

i) A river

ii) A small stream

iii) A canal

Describe briefly how you would carry out the measurements in each case.

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

Table Q5

Distance (m)	0	0.6	1.2	1.8	2.4	3.0	3.6	4.2	4.8	5.4	6.0	6.6
Depth (m)	0	0.30	1.29	2.16	2.55	2.22	1.68	1.41	1.05	0.63	0.42	0
Number of revolutions at 0.2d	0	73	101	140	157	146	135	123	112	95	78	0
Number of revolutions at 0.8d	0	33	62	95	107	50	90	78	67	56	50	0
Time (seconds)	0	60	60	60	60	60	60	60	60	60	60	0

The rating equation of the current meter is $V= 0.32N + 0.032\ ms^{-1}$. Where N is the revolutions/sec. Calculate the discharge of the stream.

6.

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

b. What are the considerations that you will make in selecting a suitable cross drainage work for a particular location?

c. What is a canal drop? Why is it necessary to provide drops?

d. Briefly explain the steps that you follow in diverting water from a river to a canal.

7.

a. Briefly explain the use and the method of carrying out the following topographical surveys necessary for the investigation of a suitable location for a reservoir.

   i) Reservoir bed survey

   ii) Dam axis survey

   iii) Spill site survey

   iv) Tail water rating curve survey

b. The area – elevation data of a proposed reservoir is given in table Q7.

Table Q7

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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