UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 7 Examination in Engineering: August 2024

Module Number: CE 7255 **Module Name: Irrigation Engineering (TE)**

[Three Hours]

[Answer **all questions**, each question carries fifteen marks]

Q1: a) i) Explain the term 'consumptive use of water' related to crop production.

[1.0 Mark]

ii) Evapotranspiration measurement has an important role in the estimation of crop water requirement. However, due to the difficulty of obtaining field measurements pertaining to evapotranspiration, a three stage prediction method is recommended by the Food and Agricultural Organization (FAO) of the United Nations to determine the crop water requirement. Explain the three stage procedure considering the effect of various factors on the crop water requirement at each stage.

[4.0 Marks]

iii) Crop water requirement calculations usually refer to the evapotranspiration of a decease free crop, grown in a very large field, not short of water and fertilizers. However, the actual crop water requirement depends on local factors, such as local variations of climate and cultural practices. Describe how the above mentioned local factors affect the crop water requirement.

[6.0 Marks]

b) In a newly established irrigation scheme, evaporation was measured onsite using a *Class A* pan and it gave a value of 13 mm/day for the month of May. The pan station was located in a middle of 300 m x 300 m fallow area. At the pan station, mean relative humidity of 40-70% and wind speed of 250 km/day were recorded. Determine the mean ET_0 at the pan station for the month of May.

In the pan evaporation method, recommended relationship for ET_0 and E_{pan} is as follows:

$ET_0 = K_p \times E_{pan}$

where;
ET_0 = reference crop evaporation in mm/day
E_{pan} = pan evaporation in mm/day
K_p = pan coefficient

You may use the data given in Table Q1 for your calculations. State any assumptions you make.

[4.0 Marks]

Q2. a) i) Explain the primary, secondary and tertiary water distribution levels of an irrigation system using a layout diagram.

[3.0 Marks]

ii) Describe the design principles that need to be adopted in designing water distribution system in order to ensure equitable water distribution at each level.

[3.0 Marks]

iii) Continuous supply, rotational supply and supply on demand are the three main methods of supplying water to the farmlands. Which method you would recommend for an irrigation scheme in the dry zone where paddy is the major crop? Justify your answer.

[3.0 Marks]

b) i) Explain the difference between the 'net irrigation requirement' and the 'actual irrigation requirement'.

[2.0 Marks]

ii) 'Contribution from groundwater' is one of the main factors that affect the irrigation requirement. Explain how it affects the irrigation requirement.

[2.0 Marks]

iii) Salinity control is an important element in sustainable irrigated agriculture. Discuss the importance of salinity control, highlighting its impact on agricultural productivity and environment.

[2.0 Marks]

Q3. a) i) When selecting a particular irrigation method, irrigation engineer must consider several factors, and choose a method which is best suited to local conditions. What are the factors that need to be considered in selecting an irrigation method?

[3.0 Marks]

ii) How does basin irrigation become advantageous over free flooding in terms of water application efficiency?

[3.0 Marks]

b) i) A farmland having sandy loam soil is required to irrigate using the basin irrigation method. How would you adjust 'size' and 'shape' of the basin in order to ensure high water application efficiency and high cultivation efficiency?

[3.0 Marks]

ii) Vegetable farm land is irrigated using the furrow method. Though it seems no shortage of water flowing in the furrows, it has been noted that the root zone of the vegetable plants has remained dry. Identify all possible reasons that could give rise to the above situation.

[3.0 Marks]

c) 'Water use efficiency can be increased by better crop and soil management practices'. Explain the validity of the above statement giving examples.

[3.0 Marks]

Q4. The primary objective of the proposed Gin Nilwala trans-basin water diversion project is to utilize the surplus water in Gin River and Nilwala River basins by diverting them to several water scares irrigation schemes located in the south-east dry zone to develop new commercial agriculture production areas.

i) How does a well-planned irrigation system support the economy of Sri Lanka?

[3.0 Marks]

ii) Describe possible water saving techniques and strategies that could be practiced by the irrigation schemes located in the water scarce dry zone in order to minimize the water losses.

[3.0 Marks]

iii) In irrigated agriculture, maintaining the soil fertility by natural means has become popular in the recent past. In this context, discuss the importance of practicing 'crop rotation' and 'intercropping'.

[3.0 Marks]

iv) The proposed irrigated-agriculture developments can bring variety of negative environmental impacts to the downstream area of the irrigation schemes. State the potential negative environmental impacts and describe the techniques that could be used to minimize them.

[3.0 Marks]

v) The following soil and crop characteristics are related to a vegetable crop to be cultivated in a newly developed dry zone farm land. In order to ensure the optimum growth of the vegetable crop, what would be the frequency of irrigation?

Available soil moisture = 120 mm/m
Root zone depth of crop = 60 cm
Daily consumptive use of water = 12 mm
Field application efficiency = 0.7
Assume allowable moisture depletion of 30% from the available soil moisture.

[3.0 Marks]

Table Q1: Pan Coefficient (Kp) for *Class A* Pan for Different Groundcover and Levels of Mean Relative Humidity and 24 hour wind.

Class A pan	Case A: Pan placed in short green cropped area				Case B 1/ Pan placed in dry fallow area			
RH_{mean} %		low < 40	medium 40-70	high > 70		low < 40	medium 40-70	high > 70
Wind km/day	Windward side distance of green crop m				Windward side distance of dry fallow m			
Light < 175	1	.55	.65	.75	1	.7	.8	.85
	10	.65	.75	.85	10	.6	.7	.8
	100	.7	.8	.85	100	.55	.65	.75
	1 000	.75	.85	.85	1 000	.5	.6	.7
Moderate 175-425	1	.5	.6	.65	1	.65	.75	.8
	10	.6	.7	.75	10	.55	.65	.7
	100	.65	.75	.8	100	.5	.6	.65
	1 000	.7	.8	.8	1 000	.45	.55	.6
Strong 425-700	1	.45	.5	.6	1	.6	.65	.7
	10	.55	.6	.65	10	.5	.55	.65
	100	.6	.65	.7	100	.45	.5	.6
	1 000	.65	.7	.75	1 000	.4	.45	.55
Very strong > 700	1	.4	.45	.5	1	.5	.6	.65
	10	.45	.55	.6	10	.45	.5	.55
	100	.5	.6	.65	100	.4	.45	.5
	1 000	.55	.6	.65	1 000	.35	.4	.45