UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 7 Examination in Engineering: May 2023

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

[Three Hours]

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

Q1. The proposed Gin Nilwala trans-basin water diversion project's main objective is to use the surplus water in Gin River and Nilwala River basins by diverting them to several irrigation schemes located in the south-east dry zone in order to develop these areas as commercial agriculture producing areas.

i) Explain how the proposed diversion will be able to meet the irrigation deficit of the existing irrigation schemes.

[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 = 150 mm/m
Root zone depth of crop = 50 cm
Daily consumptive use of water = 10 mm
Field application efficiency = 0.7
Assume allowable moisture depletion of 30% from the available soil moisture.

[3.0 Marks]

Q2. a) i) Explain the major cultivation seasons in Sri Lanka giving special reference to paddy cultivation and discuss how the above seasons relate to the rainfall pattern in the country.

[3.0 Marks]

ii) Following types of crops have been identified as the suitable types to be cultivated in the Mahaweli System H area:
Lowland paddy, soya beans, ground nuts, green gram, cowpea and chillies.
From the above list, select the crop(s) that you would recommend to be cultivated during the following seasons, explaining all the reasons for your selection.

(I) Yala season.

(II) Maha season.

[1.5 + 1.5 Marks]

b) 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 the 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]

Q3. a) Water application is the transferring of water from a conveyance system of pipes or channels into the soil where roots of the growing plants are located. When planning the irrigation schemes, several factors need to be considered in selecting the most appropriate water application method.

i) Explain the significance of the following factors on the selection of basin method of water application.

(I) Topography.

(II) Soil texture.

[1.0 + 1.0 Marks]

ii) How does basin irrigation become appropriate compared to border irrigation for a farmland having clayey soils?

[2.0 Marks]

iii) 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?

[2.0 Marks]

b) i) In furrow method of irrigation, it is recommended to maintain a slope of 0.05% (minimum) to 0.5% (maximum) inside the furrow. Explain the reasons.

[3.0 Marks]

ii) How would the following characteristics of the furrows in clayey soil differ from that of sandy soil?

I) Shape of the furrow.

II) Spacing of the furrow.

[1.5 + 1.5 Marks]

iii) 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]

Q4. a) Crop coefficients (Kc) are used to account for the effect of the crop characteristics on crop water requirements. Values of Kc relate to the evapotranspiration of a disease-free crop grown in large fields under optimum soil water and fertility conditions and achieving full production potential under the given environment. Explain how the following factors influence the value of the crop coefficient (Kc).

i) Crop planting or sowing dates.

ii) Climatic conditions.

[3.0 + 3.0 Marks]

b) Green beans are planted in an upland farm on 01st of June. During the growing season, RH min is 75% and wind speed ranged from 5 to 8 m/sec. ET_0 at initial stage is 7.5 mm/day. Irrigation frequency during the initial stage can be assumed to be 7 days.

Length of growth stages:

Initial stage:	15 days
Crop development stage:	25 days
Mid season stage:	25 days
Late season stage:	10 days

Use the data given in Table Q4 and Figure Q4 for your calculations.

i) Calculate the crop coefficients (Kc) for the four stages of crop development.

ii) Draw the crop coefficient curve.

[4.0 + 5.0 Marks]

Table Q4: Crop Coefficient (Kc) for field and vegetable crops for different stages of crop growth and prevailing climatic conditions.

Crop	Humidity		RHmin >70%		RHmin <20%	
	Wind m/sec		0-5	5-8	0-5	5-8
	Crop stage					
All field crops	initial	1	Use Fig. Q4			
"	crop dev.	2	by interpolation			
Artichokes (perennial-clean cultivated)	mid-season	3	.95	.95	1.0	1.05
	at harvest or maturity	4	.9	.9	.95	1.0
Barley		3	1.05	1.1	1.15	1.2
		4	.25	.25	.2	.2
Beans (green)		3	.95	.95	1.0	1.05
		4	.85	.85	.9	.9
Beans (dry) Pulses		3	1.05	1.1	1.15	1.2
		4	.3	.3	.25	.25
Beets (table)		3	1.0	1.0	1.05	1.1
		4	.9	.9	.95	1.0
Carrots		3	1.0	1.05	1.1	1.15
		4	.7	.75	.8	.85
Castorbeans		3	1.05	1.1	1.15	1.2
		4	.5	.5	.5	.5
Celery		3	1.0	1.05	1.1	1.15
		4	.9	.95	1.0	1.05
Corn (sweet) (maize)		3	1.05	1.1	1.15	1.2
		4	.95	1.0	1.05	1.1
Corn (grain) (maize)		3	1.05	1.1	1.15*	1.2
		4	.55	.55	.6 *	.6
Cotton		3	1.05	1.15	1.2	1.25
		4	.65	.65	.65	.7
Crucifers (cabbage, cauliflower, broccoli, Brussels sprout)		3	.95	1.0	1.05	1.1
		4	.80	.85	.9	.95
Cucumber		3	.9	.9	.95	1.0
Fresh market		4	.7	.7	.75	.8
Machine harvest		4	.85	.85	.95	1.0
Egg plant (aubergine)		3	.95	1.0	1.05	1.1
		4	.8	.85	.85	.9
Flax		3	1.0	1.05	1.1	1.15
		4	.25	.25	.2	.2
Grain		3	1.05	1.1	1.15	1.2
		4	.3	.3	.25	.25
Lentil		3	1.05	1.1	1.15	1.2
		4	.3	.3	.25	.25

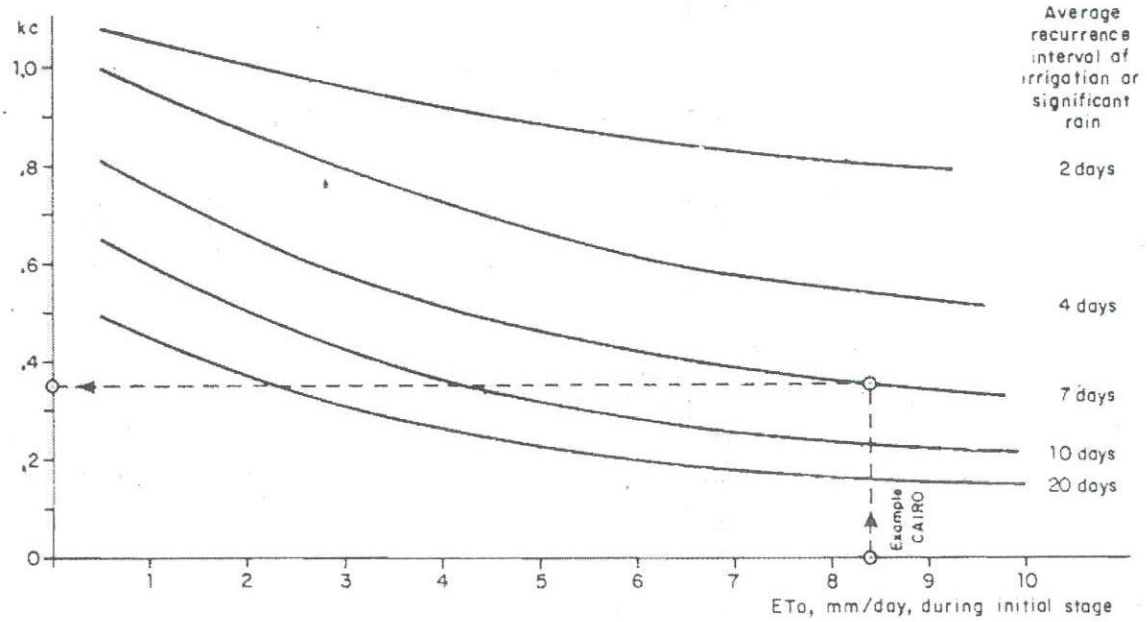

Figure Q4: Average Kc value for initial crop development stage as related to level of ET_0 and frequency of irrigation and/or significant rain.