# UNIVERSITY OF RUHUNA

**Faculty of Engineering**

End-Semester 8 Examination in Engineering: August 2022

**Module Number: CE 8252 Module Name: Irrigation and Watershed Management (N/C)**

**[Three Hours]**

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

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Q1. a) Integrated Water Resources Management (IWRM) is said to be a 'shared responsibility'. Explain the validity of the above statement giving examples.

[4.0 Marks]

b) State the benefits of IWRM to the following sectors:

i) Environment.
ii) Agriculture.
iii) Water supply and sanitation.

[3.0 Marks]

c) i) Explain the difference between 'demand' for water and 'use' of water, at the watershed level.

[4.0 Marks]

ii) Community based approach has been identified as one of the effective strategies used in sustainable watershed management. Describe the role of community based groups and organizations to manage watersheds in sustainable manner.

[4.0 Marks]

Q2. a) To ensure the optimum growth of a vegetable crop, calculate the frequency of irrigation for the crop using the following data:
Available soil moisture = 140 mm/m
Root zone depth of crop = 60 cm
Daily consumptive use of water = 10 mm
Assume allowable moisture depletion of 40% from the available soil moisture.

[3.0 Marks]

b) Explain the significance of the following soil moisture levels on the frequency of irrigation:

i) Field capacity.
ii) Permanent wilting point.

[4.0 Marks]

c) Vegetable farm land is irrigated using 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. State all possible reasons that could give rise to the above situation.

[4.0 Marks]

d) Having a fixed irrigation schedule may reduce the water application efficiency of Border method of irrigation. Explain the above statement.

[4.0 Marks]

Q3. a) Define the following terms:
i) Conveyance efficiency.
ii) Field canal efficiency.
iii) Field application efficiency.
iv) Project efficiency.

[2.0 Marks]

b) List the design principles that need to be considered in water distribution system in an irrigation scheme to ensure equitable distribution of water.

[3.0 Marks]

c) Describe the following structures with sketches and explain their operations:
i) Inverted siphon.
ii) Flow dividing structure.

[5.0 Marks]

d) Explain the impact of following factors on the irrigation requirement:
i) Stored soil water.
ii) Leaching requirement.

[5.0 Marks]

Q4. a) i) List the methods available to estimate the reference crop evapotranspiration ($ET_0$).
ii) Discuss the data requirement and accuracy of each method.

[8.0 Marks]

b) In developing a small-scale irrigation scheme, evaporation was measured onsite using a *Class A* pan and it gave a value of 11.5 mm/day for the month of February. The pan station was located in a middle of 350 m x 350 m fallow area. At the pan station, mean relative humidity of 40-70% and wind speed of 210 km/day were recorded. Determine the mean $ET_0$ at the pan station for the month of February.

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 Q4 for your calculations. State any assumptions you make.

[7.0 Marks]

Table Q4: 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 B1/ 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 |