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Section B

Semester 6th

Subject Irrigation Engineering

Date 13th April, 020

Iqra National UNIVERSITY

Q.No1 (a)

Define "Delta" and Duty and derive their relationship in MKS and FPS Systems.

Ans = DELTA :- The total quantity of water (Volume), required to the crop, to get matured, during its base period.

It means, total quantity of water divided by total irrigated place, it obtain Delta of crop of irrigated area.

DUTY :- The term duty means the area of land that can be irrigated with unit volume irrigation water.

Duty represents the irrigation capacity of a unit. It is the relation between the area of crop irrigated and quantity of irrigation water required during the entire period of the growth of that crop.

⇒ Relation of Delta and Duty in MKS

Let,

Duty = D (hectare/cumecs)

Delta = A meters Base period

= B days by definition

One cumec of water flowing continuously for "B" days gives a depth of water "A" over an area of "D" hectares.

Volume of water @ $1 m^3$sec in one day = $1 \times 24 \times 60 \times 60 = 86400\ m^3$

Volume of water @ $1 m^3$sec in "B" days.

$= 1 \times 24 \times 60 \times 60 = 86400\ B\ m^3$

$= 86400\ m^2 m$ (i)

As

1 Hectare $= 10000\ m^2$

$1 m^2 = 1104\ H$

Then, equation becomes

Volume of water @ $1 m^3$sec in B days =

$86400\ B\ m^2 = 86400 B \times 1104\ H \cdot m$. Volume of water @ $1 m^3$sec in "B" days $= 8.64 \times B\ H\text{-}m$ (ii)

$\Rightarrow$ Depth of water required by Crop, A

= Volume Area A $= 8.64 \times B\ Dm$

(b) Relation of Delta and Duty in FPS:

Let Duty = D (Acres/Cusecs)

Delta = A feet Base period = B days

By definition.

one cusec of water flowing Continuously for 'B' days gives a depth of water 'A' over an area of 'D' acres.

Volume of water 1 ft³sec in one day =

$1 \times 24 \times 60 \times 60 = 86400\ ft^3 = 86400\ ft^2\ ft$ — (i)

As

1 Acre = 43560 ft^2

eq (1) ⟹

Volume of water 1 ft³sec in "B" days = $86400\ B\ ft^3 = 86400\ B \times \frac{1}{43560}$ Acre ft

Volume of water @ 1 ft³sec in B days

$= 1.983 \times B$ Acre ft —— (ii)

Depth of water required by Crop, A =

Volume Area A = 1.983 B Acre-ft D.

Acre A = 1.983 × B D ft

D is duty in ha/cumec

(b) Numerical

If wheat requires about 9cm of water after every 35 days and base period of crop is 140 days. Find delta for wheat ?

Given data :-

Depth of water = 9 cm

Base Period = 140 days

Required data :-

Delta for wheat, $\Delta = ?$

Solution :-

No of watering required $= 140/35 = 4$

Total depth of water required = No of watering × Depth of water

$= 4 \times 9 = 36$ cm

Δ for wheat = 36 cm

Q No 2 (c)

Explain Indus water Treaty.

ANSWER

Introduction :- It was signed in year in 1960 by former Prime Minister Jawaharlal Nehru and President of Pakistan. Ayub Khan.

Purpose of Indus water Treaty :-

The purpose of indus water treaty is an agreement that was made to chalk out the control over the 6 rivers that run across India and Pakistan into the Indus Basin.

River given to Pakistan :- Control of water flowing in three western river of india Indus chenab and Jehlum with mean annual flow of 80 MAF were given to Pakistan.

River given to India :-

Eastern river of India, Bees River and sutlej with mean annual flow of 33 MAF was given to India.

Q.No.1 (d)

Significance of Duty of a crop :-

→ It helps in designing efficient canal irrigation system. Knowing the total available water at the head of the main canal and the overall duty for all the crops required to be irrigated in different seasons of the year, the area which can be irrigated can be worked out.

→ Inversely if we know the crop area required to be irrigated and their duties, we can work out the discharge required for designing the canal.

Question No 02 :

(a) Explain the factor affecting consumption use.

Answer :- The following are the factor affecting consumption use.

Temperature :- The rate of consumptive use of water by crops in any particular locality is probably affected more by temperature. which for long time period is good measure of solar radiation, than by any other factor. Abnormally low temperature retard plant growth and unusually high temperature may produce dormacy.

Humidity :- Evporation and transpiration are accelerated on days of low humidity and slowed during periods of high humidity. During period of low relative humidity, greater rate of use of water by vegetation may be expected.

Wind Movement :- Evaporation of water from land and plant surfaces takes place more rapidly when there is moving air than under calm air condition Hot, dry winds and other unusual wind conditions during the growing period will effect the amount of water consumptively used. However there is a limit in the amount of water that can be utilized. As soon as the land surface is dry. evaporation partially stops and transpiration is limited by the ability of the to extracts and convey the soil moisture through the plants.

Latitude and Sunlight :- Although latitude may hardly be called a climate factor it have considerable influence on the rate of consumptive use of water by various plants. Because of the earth movement and axial inclination, the hours of daylight during the summer are much greater in the northern latitudes than at the Equator. Since the sun is the source of all energy used in crop growth and evaporation of water this longer

period each day and to produce an effect similar to that of lengthening the growing season.

(B) Wheat is to be grown at a certain place, the useful rainfall for the whole season is cumulative consumptive use is 40 cm. Determine consumptive irrigation requirement (CIR) and field irrigation Requirement (FIR) if water efficiency is 80%.

Given data :-

Useful Rainfall (cm) = 10 cm

water application efficiency (η_a) = 80% = 0.8

Cumulative consumptive used (CU) = 40 cm

Required data :

Field irrigation Requirement (FIR) = ?

Consumptive Irrigation Requirement (CIR) = ?

Solution :-

Consumptive Irrigation Requirement CIR =

$$= CU - Re$$

$$CIR = 40 - 10$$

$$CIR = 30 \text{ cm}$$

Field Irrigation Requirement (FIR)

$= \frac{CIR}{\eta_a}$ $\qquad$ $CIR = NIR$

i.e neglect leaching requirement

$= \frac{30}{0.8} = 37.5$ cm

Result $\qquad$ CIR = 30 cm

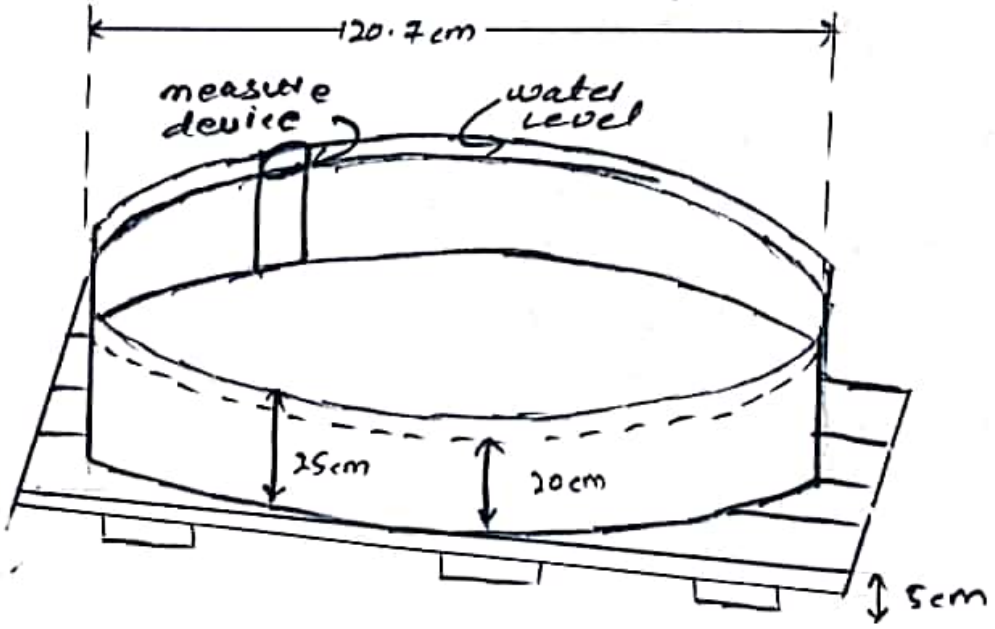
FIR = 37.5 cm

Ans 2.

(c) Explain Class A Pan Evaporation (EP) measurement with help of a diagram.

Answer :-

EP can be experimentally determined by directly measuring the quantity of water evaporated from this standard class a pan. This pan is 1.0 m in diameter 25cm deep, and bottom is raised 15cm above the ground surface. The depth of water is to be kept in a fixed range such that the water surface is at least 5cm, and never more than 7.5 cm below the top of pan.



Q.No 2 # (d)

Explain Crop Seasons (Rabi and Kharif) and Kharif Rabi Ratio ?

Answer :-

1. RABI — 1st October to 31st march - winter
2. KHARIF — 1st April to 30st septeuber — Summer

Kharif Crops : Rice Bajra Jaar Maize Cotton

Rabi crops : Wheat, Barley, Gram, Mustard potatoes, Kharif Rabi Ratio.

KHARIF RABI RATIO :-

The area to be irrigated for rabi crops generally more than that for Kharif crops. This ratio of proposed area, to be irrigated in Kharif season to that in Rabi season is called Kharif Rabi ratio. This ratio is generally 1:2 i.e. Kharif area is one half of Rabi.

Question No # 03

(a) Define and Explain the following terms.

(a) Field Capacity :- When all gravity water has drained down to water table, a certain amount of water is retained by surface soil. This water is not retained easily by drained under the action of gravity and is called Field Capacity.

Period of drainage = 2 - 5 days

FC is measured after 2 or 5 days

Field Capacity (F.C)

1. Capillary water.
2. Hygroscopic water.

(b) Permanent wilting Point :-

A plant can extract water from soil till a permanent wilting is reached P.W.P is that water content at which a plant can no longer extract sufficient water for its growth and wilts up.

water Available to plant = Field Capacity - P.W.P water.

(c) Available and Readily available Moisture content.

→ Available Moisture Content :-

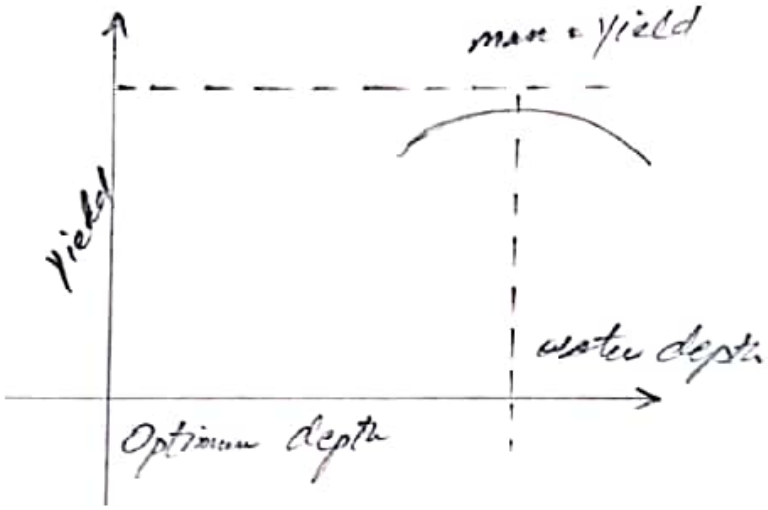
The different in moisture content of the soil between field capacity (F.C) and permanent wilting is termed as the available moisture. Available moisture can be expressed as percentage moisture.

Readily Available Moisture :-

It is the portion of available moisture which is most easily extracted by plants and is approximately 75 to 80% available moisture.

(d) Optimum utilization of water :-

→ If a crop is sown and produced under absolutely identical conditions using different amounts of water depths. The yields is found to vary. The yield increases with water, reaches a certain maximum value & then falls down as shown in following fig.



The quantity of water at which the yield is maximum is called water depth. Irrigation Efficiencies :-

Efficiency is the ratio of water output of water to the water input and is usually expressed as percentage.