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Section A

Subject Irrigation Engg

Semester 6th

Q.1 part (a)

Delta:-

The total quantity of water required to the crop to get matured, during its base period. Depth of each watering is 5cm-10cm. Simply means the total quantity of water is divided by total irrigated place, it obtains delta of the crop of irrigated area. Although it depends upon climate, weather, type of crop, type of soil, mechanism.

Delta = 864B/D

B = Base period in days

D = Duty in hectare/cumec

The delta will be in cm.

Duty:-

The term duty means the area of land that can be irrigated with unit volume of irrigation water. Duty represents the irrigating capacity of a unit unit. It is the relation between the area of the crop irrigated & the quantity of irrigation water required during the entire period of the growth that crop.

Relationship btw delta & Duty in MKS system:-

D = Duty in hectares/cumec
Δ = total depth of water supplied in meter
B = Base period in days

i. if we take a field of area D hectares, water supplied to the field corresponding to the water depth Δ meters will be
= Δ × D hectares meter = $D \times \Delta \times 10^4$ m^3 → Eq ①

ii. Again for it one cumec of water is required to flow during the entire base period. water supplied to this field
= $1 \times (B \times 24 \times 60 \times 60)$ m^3 → Eq ②

Equating Eq ① & Eq ②

$$D \times \Delta \times 10^4 = B \times 24 \times 60 \times 60$$

$$\Delta = \frac{B \times 24 \times 60 \times 60}{D \times 10^4}$$

$$\Delta = 8.64\, B/D \text{ meters}$$

1 hectare = 10^4 Sq meters
cumec day = 8.64 hectare meters.

Δ is in meter
B is days
D is in m^2.

Delta & Duty in FPS system:-

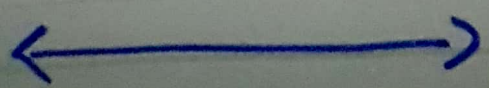
let Duty = D (Acres / cusecs)
Delta = A feet base period = B days by definition
One cusec of water flowing continously for 'B' days gives a depth of water 'A' over an area of 'D' acres.

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

Volume of water $1ft^3$ sec in B days
$= 1 \times 24 \times 60 \times 60 = 86400 ft^3$ → Eq (i)

As 1, Acre $= 43560 ft^2$
$1 ft^2 = \frac{1}{43560}$ acre then Equation (i) becomes.
volume of water $1ft^3$ sec in B days = $86400 ft^3$.
$= \frac{86400}{43560}$ Acre ft volume of water
$1 ft^3$ sec in B days $= 1.983$ B Acre ft → (ii)

Depth of water required by crop A = $\frac{\text{Volume}}{\text{Area A}}$
$= \frac{1.983 \text{ B Acre ft}}{\text{D Area A}}$
$= 1.983 \times B/D$ ft
$\Rightarrow \Delta = 1.983 B/D$ ft
where Δ is in feet
B in days
D in Acres / cusec



Q.1 part (b)

Given data:-

Water requirement of wheat = 9cm
Days interval = 35 days
Base period = 140 days

Required:-

Delta of wheat = ?

Sol:-

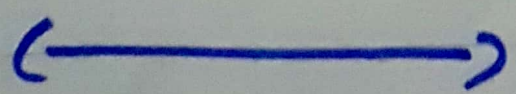
35 days = 9cm

140 days = Δ

Cross Multiplication

$$\Delta = \frac{9cm \times 140 \cancel{days}}{35 \cancel{days}}$$

$$\Delta = 36cm$$



Q.1 part (c)

Indus water Treaty:-

In 1960, Pakistan & India signed a water distribution agreement came to be known as Indus water treaty which was orchestrated by the world bank.

This agreement took nine years of negotiations & divides the control of six rivers between the two nations once signed.

Under this treaty, India got control over:-

- Beas
- Ravi
- Sutlej

Pakistan got control over:-

- Indus
- Chenab
- Jhelum

Under this treaty signed between in these two countries in 1960. All the waters of the three rivers averaging around 33 million acre feet (MAF) were allocated to india for exclusive use.

The waters of the western rivers - Indus, Jhelum & Chenab averaging to around 135 MAF were allocated to Pakistan except for specified domestic, non consumptive & agricultural use permitted to India according to the treaty.

Why it is important for Pakistan (Indus waters treaty) :-

Indus, chenab, jhelum are the lifelines of Pakistan as the country is highly dependent on these rivers for its water supply. Since these rivers do not originate from pakistan but flow to the country through india. Pakistan faces the threat of drough & famine.

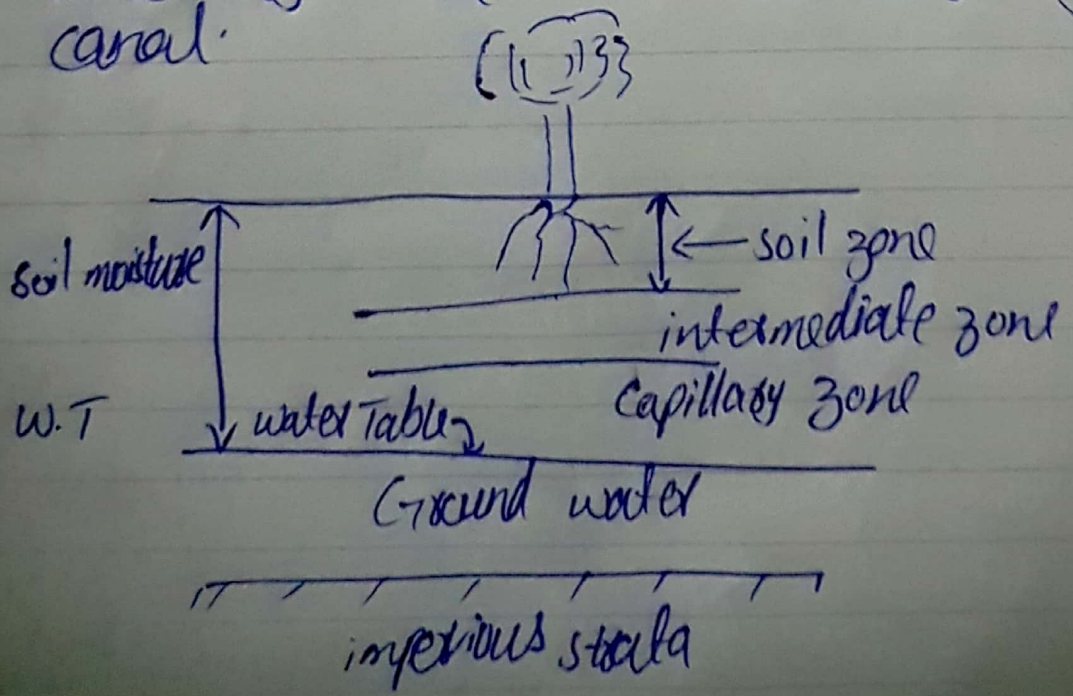
While chenab & jhelum originate from india, Indus originates from china making its way to pakistan through india.

Q.1 D part

Significan of Duty of crop :-

→ It helps in designing efficient canal irrigation system. knowing the total available water at the head of the main canal & 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 & their duties, we can work out the discharge required for designing the canal.



Q.2 part (a)

Factors Affecting consumptive use:-

i. Wind Movement:-

Evaporation of water from land & plant surfaces takes place more rapidly when there is moving air than under calm air condition. Hot, dry winds & other unusual wind condition during the growing period will effect the amount of water that can be utilized.

ii. Growing Season:-

The growing season which is tied rather closely to temperature, has a major effect on the seasonal use of water of plants. it is frequently considered to be the period between killing frosts, but many annual crops.

iii. Latitude & Sunlight:-

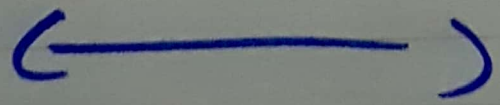
Latitude may be hardly called a climatic factor. it does have considerable influence on the rate of consumptive use of water by various plants.

iv. Available irrigation water supply:-

All the above mentioned climatic factors influence the amount of water that potentially can be consumed in given area. However, there are other factors that also cause important differences in the consumptive use-rates.

v. Quality of water:-

It is the most important thing. some investigation have shown that the quality of water supply may have an appreciable effect on consumptive use. whether or not plants actually transpire more or less if water is highly saline may be debatable.



Q.2 part (b)

Wheat is to be grown at a certain place, the useful rainfall for the whole season is 10cm & its consumptive irrigation requirement use is 40cm. Determine consumptive irrigation requirement (CIR) & Field irrigation requirement (FIR) if the water application efficiency is 80%.

Given:-

Useful Rainfall = 10cm

water application Efficiency (η_a) = 80% = 0.8

Commulative consumptive use (Cu) = 40cm

Required:-

FIR = ?

CIR = ?

Sol:-

We know that

$$CIR = Cu - Re$$

Put the values

$$CIR = 40 - 10$$

$$CIR = 30cm$$

Again we know that

$$FIR = \frac{CIR}{na}$$

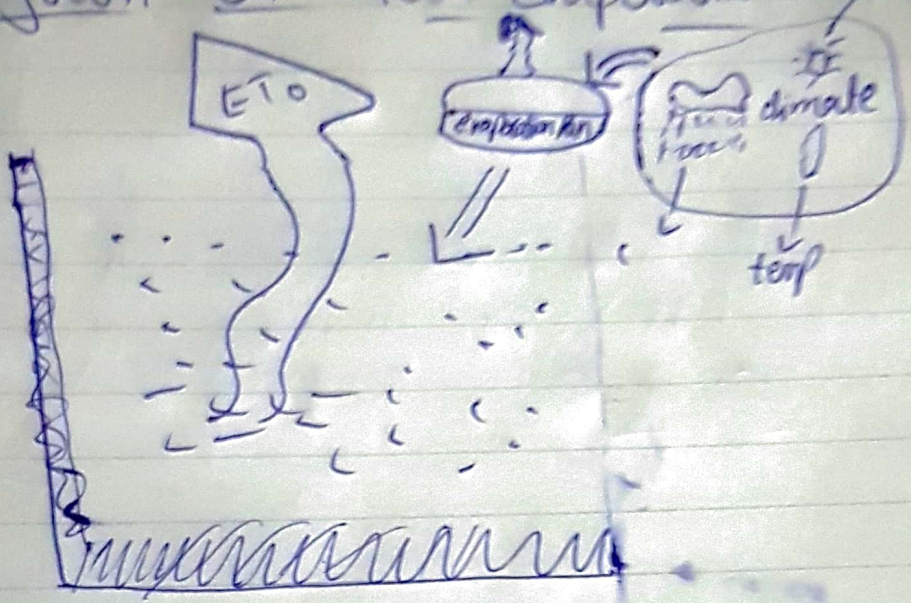
$$= \frac{30}{0.8}$$

$$FIR = 37.5 cm$$

Q.2 part (c)

Class A Pan Evaporation:- It is the measurement that combines or integrates the effects of several climate elements, temperature, humidity, rainfall, drough dispersion, solar radiation. Evaporation is greatest on hot, windy, dry, sunny days & is greatly reduced when clouds block the sun & when air is cool, calm. Pan evaporation measurements enable farmers & ranchers to understand how much water their crops will need.

Diagram of Pan Evaporation



Q.2 part D

Rabi Crops:-

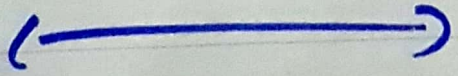
The rabi crops are sown around mid-november preferably after the monsoon rains are over, & harvesting begins in April/May. The crops are grown either with rainwater that was percolated into the ground. A good rain in winter spoils the rabi crops but is good for Kharif crops.

The major rabi crop in india is wheat, followed by barley, mustard, sesame & peas. Peas are harvested early, as they are ready early indian

markets are flooded with green peas from january to March peaking in February.

Kharif crop:-

The crops are sown in the rainy season are called Kharif crops. (also known as the summer or monsoon crop). In india Kharif crops are usually sown with the beginning of the first rains in july, during the south-west monsoon season The main monsoon season in Pakistan & india run from june to september.



Q. 3

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 which cannot be easily

drained under the action of gravity
& is called F.C.
Period of drainage = 2-5 days
FC is measured after 2 or 5 days.

Field capacity
1. Capillary water
2. Hygroscopic water.

Hygroscopic water:-
water attached to soil by chemical bonds, which can be extracted by plants by capillary action.

Capillary water:-
water attached to soil by surface tension, which can easily be extracted by plants by capillary action.

(b) Permanent wilting point (P.W.P):-

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 & wilts up. water Available to plant
= Field capacity - P.W.P water.

(C) Readily Available moisture:- (RAW)

It is that portion of available moisture which is most easily extracted by plants & is approximately 75 to 80% available moisture. RAW is the soil moisture held between field capacity & a nominated refill point for unrestricted growth. In this range of soil moisture, plants are neither waterlogged or water-stressed.

(D) Optimum utilization of water:-

If a crop is sown & produced under absolutely identical conditions using different amounts of water depths, the yield is found to vary. The yield increases with water, reaches a certain maximum value & then falls down. The quantity of water at which the yield is maximum is called optimum water depth.