Submitted by: M. Zubair Khan

Submitted To: Dr Muhammad A.Q. Jahangir Durrani

ID: 7677

Department: Civil Engineering

Subject: Irrigation Engineering

Assignment # 01

IQRA NATIONAL UNIVERSITY
PESHAWAR

# Irrigation Engineering

Q1 Part (a)

Define Delta and Duty and derive their relationship in MKS & FPS systems.

**Delta:-** The depth of water in cms or inches required for the crop throughout the base period is called Delta of the crop.

**Duty:-** The Duty of water is the relationship b/w the volume of water and the area of crop it matures.
volume of water is generally expressed by a unit discharge flowing for a time of base period of the crop.

## Relation b/w Duty and Delta (In MKS)

- Let there be a crop of base period B days. Let one cumec ($m^3$/sec) of water be applied to this crop on the field for B days.
- Now the volume of water applied to this crop during B days = $V = (24 \times 60 \times 60 \times B)\ m^3 = 86400 m^3$
- By definition of duty, $1 m^3$ of water supplied for B days matures D hectares of land. this quantity of water (V) matures D hac of land or $10^4 D m^2$ of area

Total depth of water applied on this land.
= vol / area = $\frac{8640 B}{10^4 D} = 8.64 B/D$ m
By definition the total depth of water is called Delta $\Delta$ Therefore,

$$\Delta = 8.64 B/D \text{ m}$$

$$\boxed{\Delta = 864 B/D \text{ cm}}$$

where $\Delta$ is in cm, B is in days.
D is duty in ha/cumec.

In FPS Units

$$\Delta = 1.98 B/D \text{ ft}$$

where $\Delta$ is in ft, B is in days and
D is in Acres/cusec.

Q1

Part b

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

Sol

9cm of water = 35 days

Base period = 140 days

wheat $\Delta$ = ?

So 35 days = 9 cm

1 day = 0.2571 cm

For 140 days

**140 days = 36 cm**

Q1

Part c

## Indus water Treaty

The indus water treaty is a water distribution treaty b/w Pakistan and India, brokered by the wold Bank to use the water available in the indus system of Rivers. located in India. The Treaty was signed in Karachi on sep 19, 1960 by the First prime minister of India Pandit Jawaharal Nehru & then president of Pak Ayub Khan.

The Average Annual Flow of 3 rivers : indus, jhelum chenab (called wester rivers) as a result of indus water treaty with India pass an overage annual Flow of 142 MAF

The Flow of Ravi, Beas and Sutlej, the water rights of which has been taken over under the treaty by India is 34 MAF.

The Avg. annual Flow of indus at Tarbela is 67 MAF The Kabul river contributes 26 MAF. which makes the total Flow above Attock is 93 MAF Total Mean Annual River &(discharge) annum is 133 MAF of this about 32 MAF is discharge into sea, some is lost in evaporation & infiltration to Gw reservoir.

The entire cultivable command Area (CCA) of the indus plain is 39.6 million acres.

Q.02

Part (a) : 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.

Q 2

Part a: Factors affecting Consumptive use.

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

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

(iii) Wind :-

Evaporation of water from land and plant surfaces takes place more rapidly when there is moving air than under calm air conditions, Hot dry winds and other unusual wind conditions during the growing period will affect the amount of water consumptively used.

(iv) Soil Fertility

:- If a soil is made more fertil through the application of manure or by some other means, the yields may be expected to increase in use of water. increase in fertility of the soil causes a decrease in the amount of water consumed per unit of crop yield

(v) Latitude & Sunlight

:- Although Latitude may hardly be called a climatic factor. it does have considerable influence on the rate of consumption use of water by various plants.
Because of the earth movement and axial inclination, the hours of daylight duriy the summer are much greater in the northern latitude than at the Equator.

Q2

Part b

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

Given Data

$Re = 10cm$

$Cu = 40cm$

$\eta_a = 80\%$

Required

(CIR) & (FIR)

$(CIR) = Cu - Re$

$= 40 - 10$

$\boxed{CIR = 30cm}$

$FIR = CIR/\eta_a$

$= 30/0.8$

$\boxed{FIR = 37.5cm}$

Q02

Part (c)

## Class A Pan Evaporation (Ep)

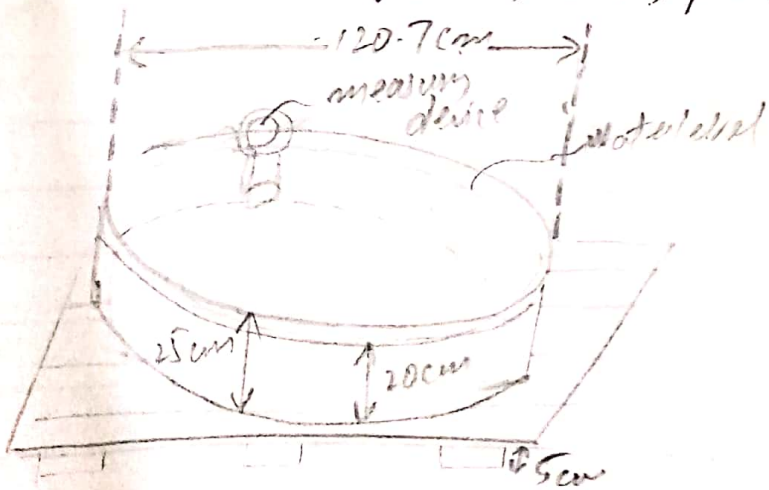
- In this method, evapotranspiration (consumptive use) is related to pan evaporation by a constant K called consumptive use coefficient

$$\text{Evapotranspiration (Et or Cu)} = K \times \text{Pan evaporation (Ep)}$$

$$Et \text{ or } Cu = K \cdot Ep$$

- Consumptive use coefficient (K) is different for different crops & is differed for the same crop at different places.
- The crop have been divided into 8 groups and the coefficient have been suggested for average condition of soil, etc.

Group A. The important crops include: sugar, beat maize, cotton, jowar, bean, peas, potatoes etc




Class A Pan Evaporation

Q2

Part d Rabi and Kharif

1) RABI :- 1st Oct to 31st March – winter

2) Kharif :- 1st April to 30st sept – Summer.

Kharif crops :- Rice, Bajra, Jawar, Maize, cotton

Rabi crops :- wheat, Barley, Gram, Mustard, potatoes.

Kharif & Rabi Ratio

The area to be irrigated for Rabi crops generally more than that for Kharif crops. This ratio of proposed areas, 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 area

Q3 Define the Following:

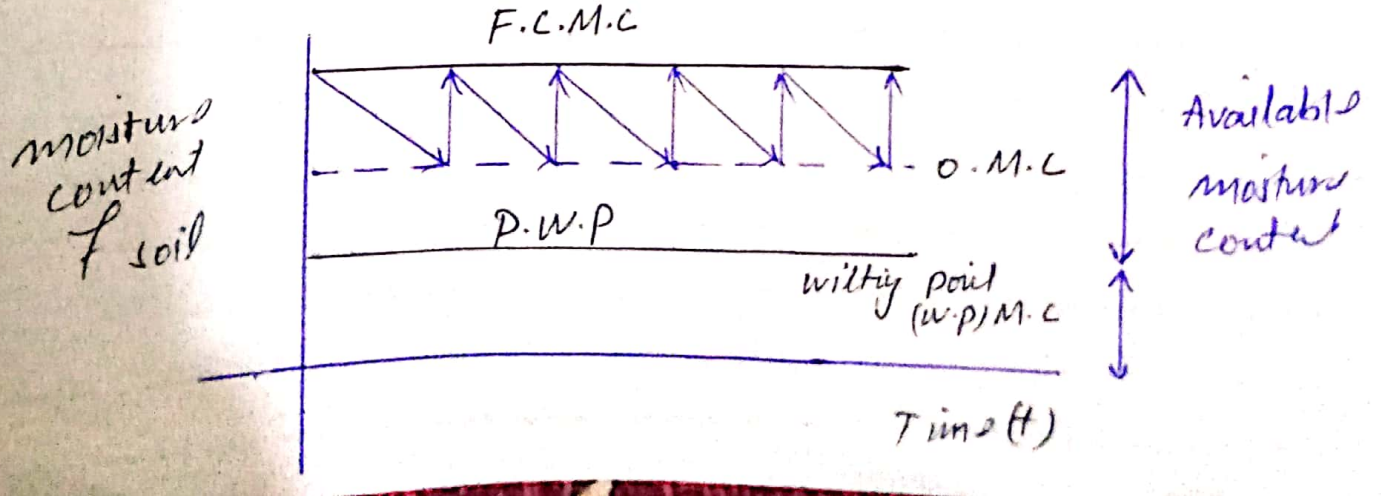
(a) Field capacity :- when all gravity water has drained down to water table, a certain amount of water is retained by surface soil. This water which can not be easily drained under the action of gravity and is called F.C.
Period of drainage = 2-5 days
Fc is measured after 2 or 5 days.
* (1) capillary water (2) Hygroscopic water

(i) capillary water :- water attached to soil by surface tension, which can easily be extracted by plants by capillary action

(ii) Hygroscopic water :- water attached to soil by chemical bonds, which can not be extracted by plants by capillary action

$$\text{Field capacity} = \frac{\text{weight of water retained in a certain vol of soil}}{\text{wt. of same vol of soil}} \times 100$$

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



## (c) Readily Available Moisture

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

## (d) optimum utilization of water

- If a crop is sown and produced under absolutely identical conditions using different amounts of water depth, the yield is found to vary. The yield increase with water, reaches a certain max value & then falls down as shown in Following Fig