Name Khalil Ur Rehman

ID 7831

Section B

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Subject "Irrigation Engineering"

Submitted To,

Dr. Engr. M.A.Q Durrani

Q. 1

a) Delta :- It is define as:

The total depth of water Required during its Base period for full growth of Crops.

It is expressed in terms of depth (cm, or inches).

Depth of each watering :

5cm (2") — 10cm (4")

It is denoted by Delta "Δ"

Duty :-

It is define as;

It is the no. of hactares of land irrigated by flow of water at rate of $1 m^3/s$ during its Complete Base period.

⊙ Mathematically it Can be written as;

$$Duty = Area / Discharge$$

⊙ Units :-

$$\Rightarrow ha/Cumecs$$

⊙ 1 cu.m per Sec or 1 cu.ft/sec of water for 'B' days mature 'D' hactare or acres of land. Ther Duty of water for that particular crop is D headare/cumecs or D acres/cusecs

Derive Relationship of Delta and Duty in MKS and FPS System.

In MKS System :-

Let;

Duty = D (hectares/cumecs)

Della = A meters base period = B days By definition.

One Cumec of water flowing Continously for "B" days gives a depth of water "A" Over an area of 'D' hectares.

Volum of water => $1m^3$ sec in One day = $1*24*60*60$
$= 86400 m^3$

Volum of water => $1m^3$ sec in 'B' days = $1*24*60*60$
$= 86400 B m^3$ (i)

As, 1 Hactare = $10000 m^2$

$1m^2 = 1104 H$

Then, equation (i) Becomes.

Volume of water => $1 m^3$ Sec in "B" days

$= 86400 B m^3 = 86400 B * 1104$ H-m

Volum of water => $1 m^3$ Sec in "B" days

$= 8.64 * B$ H-m —(ii)

Depth of water Required by Crop,

A = Volume Area "A" = $8.64 * B$ H-mD HA = $8.64 * BDm$

$= 8.64 * B/D$ meter

Thus It is derived in MKS System.

In FPS System :-

Let,

Duty = D (Acres/cusecs)

Delta = A feet Base period = B days

One Cusec of water flowing Continously for "B" days gives a depth of water "A" Over an area of "D" acres

volum of water => $1\ ft^3$ Sec in One day

$= 1*24*60*60 \Rightarrow 86400\ ft^3$

volum of water => $1\ ft^3$ Sec in "B" days

$= 1*24*60*60 \Rightarrow 86400B\ ft^3$ —(i)

As. 1 Acre = $43560\ ft^2$; $1\ ft^2 = \frac{1}{43560}$ Acre

Then equation (i) becomes

volum of water => $1 ft^3$ Sec in "B" days

$= 86400 B ft^3 \Rightarrow 86400B * 143560$ Acre-ft

volum of water => $1 ft^3$ in "B" days

$= 1.983 * B$ Acre-ft —(ii)

Depth of water Required by Crop.

A = Volume Area $A = 1.983 B$ Acre

$A = 1.983 * \frac{B}{1} ft$

Thus it is derived.

b) Given Data :-

- The depth of water Required each time = 9cm
- Base period of Wheat = 140 days

Required :-

Delta for Wheat = Δ = ?

Solution :-

No. of required waterings = $\frac{140}{35} = 4$

The depth of water required each time = 9cm

Total depth of water required in 140 day

$= 4 * 9cm = 36cm$

Hence

Δ For Wheat = 36cm Ans

c)

Indus Water treaty :-

- It is a water Sharing treaty b/w india and pakistan.
- Concept of indus water treaty was given by : Mr. David Lilienthal.
- Date of Signing the treaty : 19th Sep, 1960
- Treaty is Signed by Jawahal Lal Nehru and Ayub Khan
- President of world Bank at the time of Signing the treaty : E.R Black.
- Previously known as International Bank.

According to this Agreement :-

- Control over water flowing in three "Eastern" rivers of india Beas, Ravi and Sutlej was given to india.
- While Control over the water flowing in three "Western" rivers of india the indus, the Chenab, and the Jhelum was given to pakistan
- Governing body for indus water treaty indus water Commision.
- India can use nearly 20% of the total water carried by the indus System rivers.

⊙ 80% water the indus System used pakistan.

⊙ Duration of transition period in which india was bound to Supply water to pakistan From estern rivers — (10 years)

(For Building the Canal system For western rivers.

Talbul Navigation Project :- Stopped in 1984 due to indus water treaty.

Jammu and Kashmir :- State is worst effected by the indus water treaty.

⊙ 10 year transition period ended.

d]

Significonce of Duty of a Crop :-

⊙ It helps us in designing an efficient Canal irrigation System Knowing the total available water at the head of a 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.

⊙ Inversly if we know the Crops area required to be irrigated and their duties. We can work out the discharge required for designing the Canal.

Q.2

a) Factors affecting Consumptive use :-

(i) Humidity :- If humidity is high then there is less space in the air particles to accomodate more water hence water which is present in the soil zone will not be able to come out hence evaporation will be less resulting in less value of Consumptive use.

(ii) climate :- If Summer then evaporation will be high and humidity will be less on resulting Consumptive use will be High.

(ii) Mean Monthly Temperature :-

If temperature high then the evaporation will be high an a Resulting the Consumptive use will be high.

(iii) Crop period :-

If Some Crop as present in the field for more No. of days then it will use more water an a Resulting in higher value of Consumptive use.

(iv) Soil and its topography :-

⊙ If Soil is high permeable then evaporation will be high as a resut Consumptive use High.

⊙ If Soil is low permeable then evaporation will be less as a result Consumptive use will low.

⊙ it also depend upon on the topography

⊙ If topography is Irregular then larger Surface area is effected by Sunlight as evaporation will be high as a result Consumptive use will be High.

⊙ If a Topography is plain So less Surface area will be effected of Sunlight as a evaporation will be less as Result Consumptive use is less.

(v) Wind movement :-

Evaporation of water from land and plant surface take place more rapidly when there is moving air then under calm air condition. Hot, dry winds and other unsual wind condition during the growing period will effected the amount of water consumptively used. However there is a limit in the amount of water that can be utilized. As soon as land surface is dry evaporation practically stops and transpiration is limited by ability of plant to extract and convey soil moisture in plant

b)

Given Data :-

useful Rainfall = 10cm

water application effeciency = η_a = 80% ∵ 80% = 0.8

Commulative Consumptive use = Cu = 40cm

Required :-

⊙ Field irrigation Requirement (FIR) = ?

⊙ Consumptive irrigation Requirement (CIR) = ?

Solution :-

As we know that:

$CIR = Cu - Re$ ∵ Cu = 40cm, ∵ Re = 10cm

$CIR = 40 - 10$

$\boxed{CIR = 30cm}$

Also $FIR = \frac{CIR}{\eta_a} \Rightarrow FIR = \frac{30}{0.8}$ ∵ $\eta_a = 0.8$

$\boxed{FIR = 37.5cm}$

Ans//

with the help of Diagram :-

⊙ A class A Evaporation pan is Standard device for manual measurement of evaporation.

⊙ The pan ~~body~~ represented the Open body of water.

⊙ Ep Can be experimentally determined by directly measuring the Quantity of water evaporation from this standard class a pan this pan is 1.0m in dia, 25cm deep and bottom is rased 15cm above the ground Surface the depth water is to be Kept in a fixed range Such that the water surface is at

5cm and Never more than 7.5cm below the top of the pan.

⊙ The pan evaporation can also determine by using the christiansen formula which states;

$$Ep = 0.459 R.ct.cw.ch.Cs.Ce$$

R = extra. Terrestrial radiation in the Same unit as Ep in "cm" or "mm"

ct = Co efficent For temperature.

Cw = Co-efficent For wind velocity.

Ch = Co-efficent For relative humidity

Cs = Co-efficent For persent of possible Sun Shine.

Ce = Co-efficent For elevation.

Diagram:- "class A Evaporation pan Fig (K)

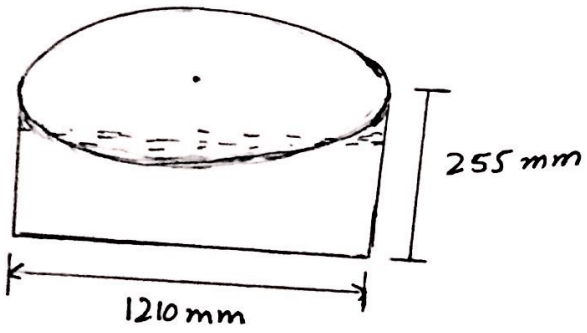

Fig (K)

- ⊙ water in it (180 – 200 mm)
- ⊙ Evaporation at certain time is called pan evaporation. (at occur at any time)
- ⊙ Height of pan = 255 mm
- ⊙ Dia of pan = 1210 mm

d)

Rabi Crop Season :-

- It is also known as winter Crop.
- Crops that are grown in the winter Season and harvested at the begining of Summer are called Rabi crops.
- The are usually Sown in the month of November and harvested in March.
- The Rabi crops are cultivated in the dry Season So timely irrigation is Required to grow these Crop.

Examples :-

- Gram.
- peas.
- Wheat.
- mustard
- Oat etc

Kharif Crops :- Season

- It is also know as monsoon crop.
- Crops that are sown in the rainy season and harvested in winters are called Kharif crops.
- The main months of cultivating the crops are July to October.
- Kharif crops depend on the rainfall patterns.
- The timing and Quantity of rainwater are important factor that decided the out put of Kharif crops.

Example:-
- Groundnut
- Soybean
- maize
- paddy

etc

Kharif Rabi Ratio :-

⊙ It is also known as crop ratio.

⊙ The area to be irrigated for Rabi crop is generally more than that for the Kharif crop. This Ratio of proposed areas, to be irrigated in Kharif Season to that in the Rabi Season is called Kharif - Rabi Ratio. It

⊙ This Ratio is generally 1:2 i.e Kharif area is one-half of the Rabi area.

Q.3

a) **Field capacity :-**

Immediatley after a rain or irrigation water application when all the gravity water has drained down to the water table, a certain amount of water is retained on the surface of ~~water~~ soil grains by molecular attraction and by loss chemical bonds. This water can not be easily drained under the action of gravity and is called the field capacity The field capacity is thus the water content of soil after drainage

Free drainage has taken place for a Sufficient period. This period of free gravity drainage is generally taken as 2 to 5 days.

The Field Capacity water is expressed as the ratio of the weight of water contained in the Soil to the weight of the dry Soil retaining that water; i.e

$$\text{Field Capacity} = \frac{\text{Wt. of water retained}}{\text{vol. of soil}}$$

b/ **Permanent wilting point** :-

plant roots are able to extract water from a Soil matrix which is Saturated up to field capacity. However, as the water extraction proceeds the moisture Content diminishes and the negative (gauge) presser increases At one point the plant Connot extract any further water and thus wilts.

Two stages of wilting points are recognized and they are;

1. Temporary wilting point:-

This denotes the Soil water content at which the plants wilts at day time, but recovers during night or when water is added to Soil.

2. Ultimate wilting point:- at Such a Soil water content, the plant wilts and fails to regain life even after addition of water to Soil.

c)

Available Moisture :-

The difference in water content of soil b/w field capacity and permanent wilting is known as available water or available moisture.

Readily Available Moisture :-

It is that portion of the available moisture that is most easily extracted by plants and approximatly 75% of the available moisture.

d) Optimum Utilization OF water :-

⊙ IF a crop is Sown and produced under absolutely identical conditions using different amount of water depths. the yield is found to vary. The yield increases with water, reaches a certain maximum value and then falls down as Shown in Fig (9)

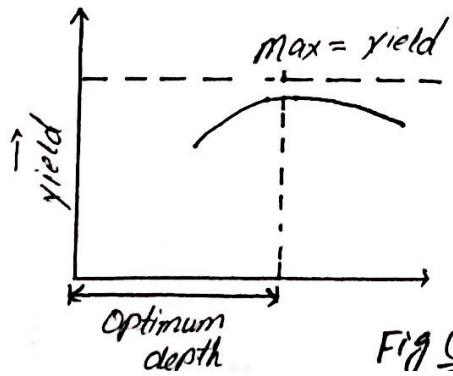

Fig (9)