Question #1 (Sol)

(a) **Delta:-**

The depth of water in cm or inches required for the crop through out the base period is called delta of the crop

Duty:-

The duty of water is the relationship between 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

Significance of duty of 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

(P.t.o)

(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.

(c) Canal Head Regulator :-

A structure which is constructed at the head of the canal to regulate flow of water is known as canal head regulator.

It consists of a number of piers which divide the total width of the canal into a number of spans which are known as bays. The piers consist of number tiers on which the adjustable gates are placed and put in eqn ① and determine V_0

Step #2 $\because Q = AV$

$A = Q/V \Rightarrow A = BD + D^2/2$

$\because P = B + D\sqrt{5}$

$\because R = A/P$

Step #3 Substitute the value of R in eqn ② to obtain V

Step #4 If the velocity worked out from eqn ② agrees with that of obtained with the eqn ③ then assumed depth is correct otherwise repeat it.

Design Procedure by LACEYS

(1) Calculate Velocity

$$V = \frac{Qf^2}{140}$$

Question # 3

(a) Kennedy's theory Differ from Lacey's theory for the Design of Irrigation canals :

→ According to Kennedy, a channel is regime (No Silting, No Scouring) but according to Lacey even though channel with no silting or scouring may actually be not in regime

→ He differentiated between Initial and final regime but this theory is applicable to final regime.

Kennedy procedure for Canal Design :

Step 1 Assume the trial value of D

P.T.O

(2) $V_m = \left(\frac{Qf^2}{140}\right)^{1/6} \Rightarrow V_m = \left(\frac{30 \times 1.317^2}{140}\right)^{1/6}$

$\Rightarrow \boxed{V_m = 0.848 m/s}$

(3) $R = \frac{5}{2}\left(\frac{v^2}{f}\right) \Rightarrow R = \frac{5}{2}\left(\frac{0.848^2}{1.317}\right)$

$\Rightarrow \boxed{R = 1.37m}$

(4) $P = 4.75\sqrt{Q}$ $\quad P = 4.75\sqrt{30}$

$\Rightarrow P = 26.02m$

(5) $S = \frac{f^{5/3}}{3340 Q^{1/6}} \Rightarrow S = \frac{1.317^{5/3}}{3340 \cdot 30^{1/6}}$

$\Rightarrow S = 0.0002687$

(6) $A = \frac{Q}{V_m} \Rightarrow A = \frac{30}{0.848} = \boxed{35.38m^2}$

(d) Under sluices :-

Under sluices are also known as scouring sluices. The under sluices are the opening provided at the base of the weir or barrage, These openings are provided with adjustable gates, Normally, the gates are kept closed, The suspended silt goes on depositing infront of the canal head regulator.

When the silt deposition becomes appreciable the gates are opened and the deposited silt is loosened with an agitator mounting on a boat.

→ At the period of flood, the gates are kept opened.

End

Q # 4

(a) Field Capacity :-
(F.C)

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 Field Capacity

Period of drainage = 2 — 5 days

FC is measured after 2 or 5-days

Field Capacity .

1→ Capillary water

2→ Hygroscopic water

P.T.O

(2) Work out $R = \left(\frac{5}{2}\right)\left(\frac{V^2}{f}\right)$

Compute $P\,Q\,4.75\sqrt{Q}$

Compute $S = \frac{f^{5/3}}{3340\,Q^{1/6}}$

Q # 3 (b) Solution

$Q = 30$ cumec

$M = 0.56$ mm

(i) $f = 1.76\, m^{0.5}$

$\Rightarrow f = 1.76\, 0.56^{0.5}$

$\Rightarrow f = 1.317$

P.T.O

(3) **By Introducing Crop Rotation :**

High water requiring crop should be followed by one requiring less water, and then by one requiring almost no water.

(4) **Optimum Use of Water :-**

Certain amount of water gives the best result, less or more water reduce the yield, cultivators should be educated so that not to use more water

(5) **Improving natural drainage of Area :-**

Water should not be allowed to stay in one area

→ Natural flow is provided by bush and jungle cutting

(6) **Pumping of Tube wells :-**

Canal irrigation may be substituted by tube well irrigation

p.t.o

Land Grading :-

- → It is a Continous land slope towards field drains
- → It is necessary for surface irrigation

→ Deep surface Drains :

They carry the Seepage water from tile drainage. They Carry storm water and excess of irrigation water

Surface INLET :

- → A Surface Inlet is a structure Constructed to carry the pit water into subsurface drain
- → The surface water from pot hole depressions road ditches may be removed by 1. random field drain or 2 Inlet surface

(P.T.O)

For preventing Salinity of lands

- An efficient drainage (surface and subsurface) must be provided to lower the WT in Saline soils

Leaching :

In this process

- Land is flooded with water
- Alkaline salts will be dissolved in water
- Percolation to the ground water
- Drained by sub surface drains

$$Na_2CO_3 + CaSO_4 \longrightarrow Na_2SO_4 + CaCO_3$$

Surface Drainage :

- Removal of excess of water using open ditches, field drains, land grading
- Shallow surface drains carry runoff to point of entrance to outlet ditches

(P.t.o)

(7) Economical Use of water :-
According to need.

(8) Adoption of sprinkler Method of Irrigation
- → Only predetermined amount of water is supplied to land
- → No percolation losses from water courses.

(C) Methods Adopted To Reclaim Saline Soils

How to avoid Efflorescence, the following key points are very important.

- → By maintaining the water table sufficiently below the roots.
- → Hence all the measures which are suggested for preventing water logging hold good

P.T.O

⑦ Submergence due to floods:-

Continued floods causes the growth of water-loving plants which obstruct natural surface drainage and increase the water-logging

⑧ Irregular and flat topography:-

In depressions the drainage is poor, water detention is more, the percolation increase the WT.

ⓑ Anti-water logging Measures:-

① Lining of Canals and water courses:-

It reduces seepage of water

② Reducing Intensity of irrigation:-

Only small portion of land should receive canal water in one particular season.

P.T.O

Extensive Irrigation: to be followed to avoid water logging.

(2) Seepage : of water from adjoining high lands

(3) Seepage of : water through canal reservoirs.

(4) Impervious obstruction : Water seeping below the soil moves horizontally it may find obstruction and WT may rise

(5) Inadequate Surface Drainage :
Storm water and excess of irrigation water should be removed. if proper drainage is not provided water percolates to rise WT.

(6) Excessive Rains :
→ Causes temporary water logging
→ No drainage causes permanent

P.t.o

Periods of days of ~~low~~ high humidity.

Wind Movement :-

Evaporation of water from land and plant surfaces takes place more rapidly when there is moving air than under calm air conditions.

Growing Season :-

The growing season which is tied rather closely to temperature has a major effect on the seasoned use of water by plants. It is frequently considered to be the period between killing frost, but for many annual crops, it is shorter than the frost-free period.

Quality of Water :-

Some Investigations have shown that the quality of the water supply may have an appreciable effect on consumptive use, wheter or not plants

P.T.O

actually transpire more or less.

Soil Fertility :-

if a soil is made more fertile through the application of manure or by some other means, the yield may be expected to increase with an accompanying small increase in use of water.

Question # 2

(a) **Principal Causes and ill Effects of water logging**

The following are the causes of water logging

1 **Intensive Irrigation :-** if max area of land is irrigated, percolation of water takes place, This cause the rise of WT

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Q1 (c) **Factors Affecting Consumptive Use**

The following are the main factors affecting the consumptive use

- → Temperature
- → Humidity In Air
- → Velocity of wind
- → Soil Topography
- → Sunlight
- → Quality of water
- → Growing Season
- → Growing Season
- → Precipitation

Temperature :-

The rate of consumptive use of water by crops in any particular locality is probably affected more by temperature, which for long-time periods is a good measure of solar radiation than by any other factor.

Humidity :

Evaporation and respiration are accelerated on days of low humidity and slowed during

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

(Q1) (b) Solution

Number of required watering $= \frac{140}{35}$

$= 4$

∴ The depth of water required each time $= 10\,cm$

∴ Total depth of water required in 140 days $= 4 \times 10\,cm$

$= 40\,cm$

Δ For wheat $= 40\,cm$