Final Term Paper

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Section 'A'

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Subject Irrigation Engineering

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Question NO #01

Part - a :- Explain anti water-logging measures.

Answer :- Anti water logging :-

⇒ Quantity of water into soil below is reduced.
⇒ Inflow into underground reservoir is reduced and outflow should be increased.

Method of anti water logging

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.
★ Remaining areas can receive water in next season by rotation.

③ Introducing crop rotation :-

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

Example :- Rice followed by wheat and then by cotton.

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.
Revenue should be charged on the basis of quantity of water rather than the area of land.

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 or Tubewells :-

★ Lift irrigation should be introduced to use GW.
★ Canal irrigation may be substituded by tubewell irrigation.

⑦ Adoption and sprinkler method of irrigation :-

★ Only predetermined amount of water is supplied to land
★ NO percolation losses from water courses.

Question #01

Part-b Differentiate b/w saline and alkaline soil.

Saline Soils	Alkaline Soils
① Definition:- Saline soils are the soils that have PH in between 7 and 8.5 and an exchangeable sodium percentage b'tween 15%.	Definition:- Alkaline soils are the soil that have a PH greater than 8.5 and an exchangeable sodium percentage greater than 15%.
② PH:- The PH of saline soil less than 8.5	PH:- The PH of alkaline soil are greater 8.5.
③ Exchangeable Sodium percentage	
The saline soil Exchangeable sodium percentage are less than 15%	The alkaline soil Exchangeable sodium percentage are greater than 15%
④ Electrical conductivity	
The saline soil is electrical conductivity is 4 or more mmhos/cm	The electrical conductivity of the alkaline soil are usually less than 4 mmhos/cm.
⑤ Organic matter content	
The organic matter content of saline soil is High.	The organic matter content of alkaline soil are Low.

⑥ Most common ions

⇒ Mainly Sodium Chloride and Sodium sulfate. Also Calcium Chloride, Calcium sulfate, Calcium bicabonate, Magnesium Sulfate and Magnesium bicarbonate in small amount.	⇒ Mainly Sodium Carbonate Potassium carbonate, Calcium Carbonate and magnesium carbonate in small amounts.

⑦ Colour of soil

The colour of saline soil are white or light gray	The colour of alkaline soil is black.

Question # 01

Part-C How do you ~~mean~~ reclaim salt affected land?

Answer:- **Reclaim Salt Affected Land**

⇒ By maintaining the water table sufficiently below the roots.

⇒ Hence all the measure which were suggested for preventing water logging land or held good for preventing salinity of land.

⇒ An efficient drainage (surface and subsurface) must be provided to lower the water table in saline soil.

Leaching:-

(1) Land is flooded with water

(2) Alkaline salts will be dissolved in water.

(3) percolation to the ground water.

(4) Drained by sub surface drains

⇒ High salt resistant crops like rice are grown on leached land for 1 or 2 season.

⇒ Then ordinary crops like wheat or cotton are grown

⇒ Then the land is said to have reclaimed

⇒ When sodium carbonate is present in the soil gypsum is added before leaching.

⇒ Sodium sulphate is formed which is leached out easily.

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

Question No #02

Part-a: Explain the procedure of designing of an irrigation canal by Kennedy's theory.

Procedure of Kennedy's Theory for Designing of Canal:

Step=01: Assume the trial value of D and put in equation 1 and determine

$$V_o = 0.54 m D^{0.64}$$

Step #02: In equation 1

$$Q = AV$$

$$A = Q/V$$

$$A = Q/v$$

$$A = BD + D^2/2$$

$$P = B + D5^{1/2}$$

For Assumed D determine B.

Find $R = \frac{A}{P}$

Step #03:- Substitude the value of R in equation 2. & obtained V which will be the actual velocity for assumed dimension.

Step #04: If the velocity worked out equation 2 agree with that of obtained with equation 3 then the assumed depth is correct. Otherwise repeated the procedure with changed value of D.

Assumption of Kennedy :-

(1) Vertical component of eddies support the silt particles

(2) The silting power of a channel depends upon its velocity, which controls the eddies.

(3) The silt transporting power depends upon its depth

(4) The silt transporting power of a channel is independent of bed width.

Kennedy :-

(1) Arbitrary fixed the ratio B/D

(2) Used chazy and Kutter Equation to find V.

(3) N = 0.0025

The equation chosen by Kennedy are

(1) $Q = AV$ (2) $V = C(RS)^{1/2}$

$$C = \frac{\frac{1}{n} + \left(23 + \frac{0.00155}{S}\right)}{1 + \left(23 + \frac{0.00155}{S}\right)\frac{n}{\sqrt{R}}}$$

(3) $V_o = 0.546 m D^{0.64}$

Question #02

Part-B :- Design an irrigation channel by Kennedy theory to carry a discharge of 30 cumecs with CVr(m) of 1 & N as 0.0225 and bed slope of 1 in 5000. Assum the depth D = 2.3m

Given Data :-

- ★ Discharge Q = 30 m^3/sec
- ★ CVr (m) = 1
- ★ N = 0.0225
- ★ Bed slope = 1 in 5000
- ★ Depth = D = 2.3m

Solution :-

Finding velocity

$$V_k = 0.546\, m\, D^{0.64}$$

$$V_k = 0.546(1)(2.3)^{0.64}$$

$$\boxed{V_k = 0.93\ m}$$

⇒ Calculate Area of canal, By formula

$$Q = AV \Rightarrow A = Q/V$$

$$A = \frac{30}{0.93}$$

$$\boxed{A = 32.25\ m^2}$$

Now we have to calculate B. By formula

$$A = BD + \frac{D^2}{2}$$

$$32.25 = B(2.3) + 0.5(2.3)^2$$

$$32.25 - 2.645 = 2.3B$$

$$B = \frac{29.605}{2.3}$$

$$\boxed{B = 12.87 m}$$

⇒ To calculate welted perimeter.

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

$$P = 12.87 + \sqrt{5}(2.3)$$

$$\boxed{P = 18.01 m}$$

⇒ Calculate Hydraulic Radius

$$R = A/P = \frac{32.25}{18.01}$$

$$\boxed{R = 1.79 m}$$

Calculating mean Velocity from chezy equation

$$V_c = c(Rs)^{1/2}$$

$$c = \frac{\frac{1}{n} + \left(23 + \frac{0.00155}{s}\right)}{1 + \left(23 + \frac{0.00155}{s}\right)\frac{n}{\sqrt{R}}}$$

$$c = \frac{\frac{1}{0.025} + \left(23 + \frac{0.00155}{1/5000}\right)}{1 + \left(23 + \frac{0.00155}{1/5000}\right)\frac{0.025}{\sqrt{1.79}}}$$

$$c = \frac{75.19}{1.517}$$

$$c = 49.56$$

Now

$$V_c = c(Rs)^{1/2}$$

$$V_c = 49.56\left(1.79\left(\frac{1}{5000}\right)\right)^{1/2}$$

$$\boxed{V_c = 0.93m}$$

Question #03

Part - a : Differentiate blw initial regime and Final Regime in according to Laceys theory.

Lacey Theory :- * According to Lacey even through 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.

Initial Regime :-

* When only bed slope of channel change but the cross section remains same then also no siltings or scouring take place. But this is rare.

Final Regime :- If all parameters (perimeter, depth & slop) have equally free to vary and adjust according to discharge and silt grades then the Channel is said to have final regime.

★ In final regime the cross section assumes semi ellipse.

★ The channel is said to be regime when the following condition are satisfied.

① The channel is flowing in unlimited, in-coherent alluvium of some character (grade)

② Silt grade and silt charge is constant

③ Q is constant

$$V_m = \left[\frac{Qf^2}{140}\right]^{1/6}$$

$$f = 1.76\, m^{0.5}$$

f = Lacey silt factor

Q = cumecs

m = mean dia in "mm"

$$R = \frac{s}{2}\frac{v^2}{f}$$

$$P = 4.75\sqrt{Q}$$

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

Question = 3

Part-b :- Design a regime channel by Lacey theory for discharge of 30 cumecs and mean diameter silt particles of 0.56mm

Given Data :-

$Q = 30\ m^3/sec$

$m = 0.56mm$

Solution :-

Lacey silt factor = $f = 1.76 \times m^{0.5}$

$f = 1.76 (0.56)^{0.5}$

$f = 1.3$

Find Velocity :-

$$V_m = \left[\frac{Q f^2}{140}\right]^{1/6} = \left[\frac{30 \times (1.3)^2}{140}\right]^{1/6}$$

$$\boxed{V_m = 0.84\ m/sec}$$

Find Area (A) :-

$Q = AV \Rightarrow A = Q/V$

$A = 30/0.84$

$$\boxed{A = 35.54\ m^2}$$

Find Perimeter = P = ?

Now $P = 4.75\sqrt{Q}$

$P = 4.75\sqrt{30}$

$\boxed{P = 26.01\,m}$

Calculate Radius (R).

As we know that

$$R = \frac{S}{2} \times \frac{V^2}{f} = \frac{S}{2} \times \frac{(0.844)^2}{1.3}$$

$\boxed{R = 1.36\,m}$

Now

$$A = BD + \frac{D^2}{2}$$

$$35.54 = BD + \frac{D^2}{2} \rightarrow (1)$$

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

$$26.01 = B + 2.236D$$

$$B = 26.01 - 2.236D \rightarrow (2)$$

putting eq ② in eq ①

$$35.54 = (26.01 - 2.236D)D + \frac{D^2}{2}$$

$$35.54 = 26.01D - 1.736D^2$$

$$\underset{a}{-1.736D^2} + \underset{b}{26.01D} - \underset{c}{35.54} = 0$$

$$a = -1.736 \qquad b = 26.01 \qquad c = -35.54$$

By Quadratic formula

$$D = \frac{-(26.01) \pm \sqrt{(26.01)^2 - 4(-1.736)(-35.54)}}{2(-1.736)}$$

$D = 1.52$ putting eq ②

$$B = 26.01 - 2.236(1.52)$$

$$\boxed{B = 22.611\ m}$$

Now $$S = \frac{f^{5/3}}{3340 Q^{1/6}} = \frac{(1.3)^{5/3}}{3340(70)^{1/6}}$$

$$\boxed{S = 0.00076}$$

Question # 04

Part-a Explain the components of head works with neat diagram?

Head Work :- Any hydraulic structure which supplies water to the off-taking canal is called head works.

-: Component of Head Work :-

(1) Wire :- ★ Normally the water level of any perennial river is such that it cannot be diverted to the irrigation canal.

★ The bed level of the canal may be higher then the existing water level of the river

★ In such case wire is constructed across the river to rise the water level.

★ Surplus water pass over the crest of wire

★ Adjustable shutters are provided on the crest to rise the water level to some required height.

② Barrage :- When the water level on the up stream side of the wire is required to be raised to different level at different time, barrage is constructed.

Barrage is an arrangement of adjustable gates or shutters at different times over the wire.

③ Under sluices :-

★ Also known as scouring sluices.

★ The under sluices are the opening provided at the base of the wire or barrage.

★ These openings are provided with adjustable gates. Normally, the gates are kept closed.

★ The suspended silt goes on depositing in front to the canal head regulator.

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

★ The gates are then closed. But, at the period of flood, the gates are kept opened.

④ Divide wall :- The divide wall is a long wall constructed at right angle in the wire or barrage, it may be constructed with stone mansory or cement concrete.

★ on the upstream side, the wall is extended just to cover the canal head regulator and on the down stream side it is extended up to the launching aporn

⑤ Fish Ladder :- The fish ladder is provided just by the side of the divided wall for the free movement of fishes.

★ River are important source of fishes.

★ The tendency of fish is to move from upstream to down stream in winters and from down stream to upstream in monsoons.

★ The movement is essential for their survival.

★ Due to construction of wire or barrage, this movement gates obstructed, and detrimental to the fishes.

★ In the fish ladder, the table wall are constructed in a zigzag manner so that the velocity of flow within the leader does not exceed 3 m/sec

⑥ 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.

⑦ Silt regulator work:-

The entry of silt into a canal which take off from a head work can be reduced by constructing certain special work called silt regulator work.

⑧ River Traing work:-

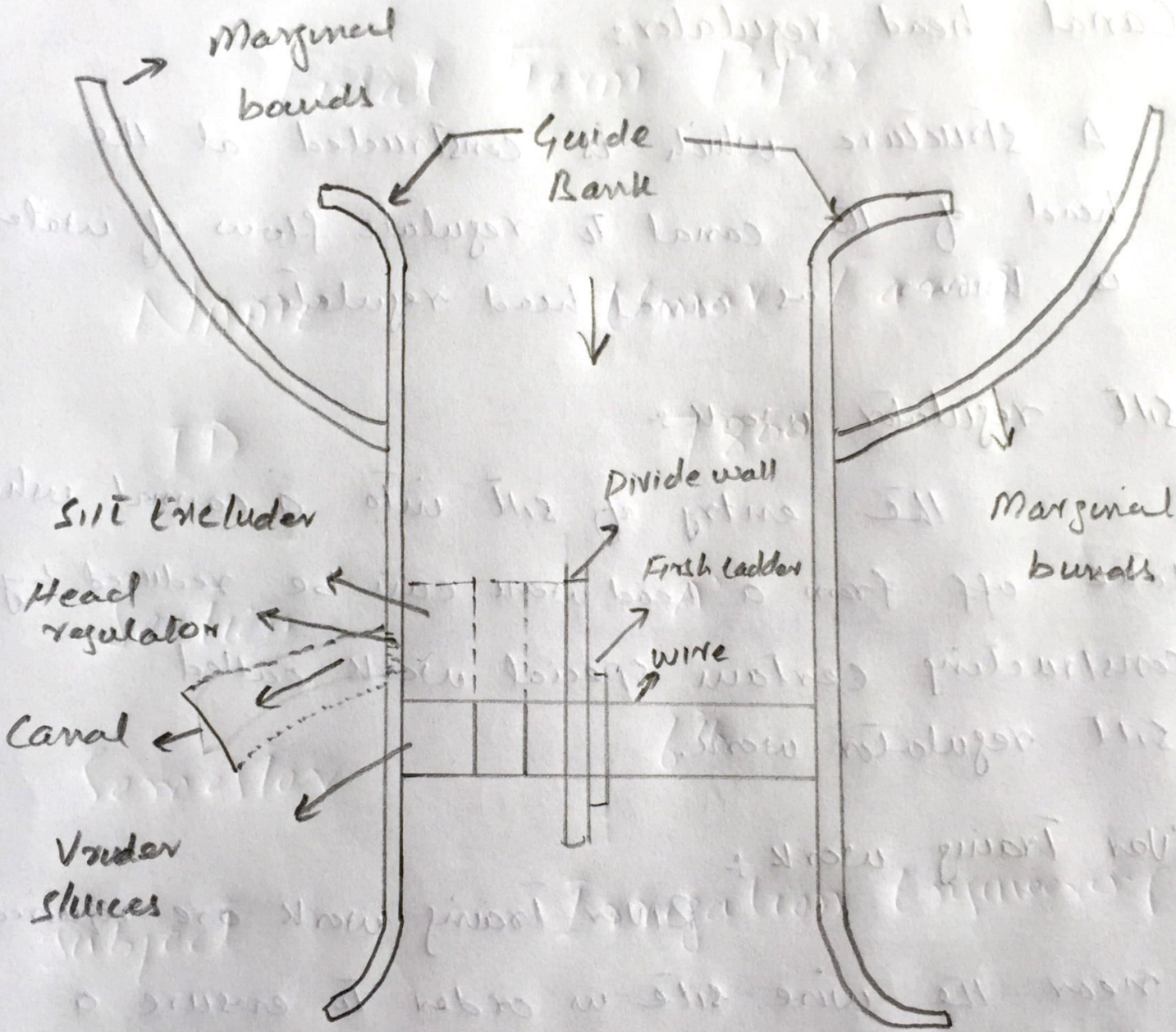
River traing work are required near the wire site in order to ensure a smooth and an axial flow of water.

⑨ Guid Bank:-

When a barrage is construcied across a river which flow through the alluvial soil the guide bank must be construcied on both to approch to protect the structure from erosion.

⑩ Marginal Bunds:-

The marginal bund are calleu embankment which are constructed parallel to the river bank.


Marginal bunds
Guide Bank
Divide wall
Silt Excluder
Fish ladder
Marginal bunds
Head regulator
wire
Canal
Under sluices

Question 4

Part - b Write the function Head regulators.

Head Regulator :-

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

→ Function of Head Regulator :-

* It regulates the supply of water entering the canal.
* It controls the entry of silt in the canal.
* It prevents the river ~~food~~ floods from entring the canal

The END