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Section = A

Subject = Irrigation Engineering

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Exam = Final -term

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QNo (01)

Part (a)

Explain anti water-logging measures.

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

Methods of control of 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) By Introducing Crop rotation.
→ High water requiring 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 or Vertical Drainage:
should be introduced to use G.W. Lift irrigation may be substituted by canal irrigation tube well irrigation

(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

Part (b)

Differentiate between saline and alkaline soils.

Ans
→ Saline soils: By maintaining the water table sufficiently below the roots.
→ Hence all the measures which were suggested for preventing water logging hold good for preventing salinity of lands
→ An efficient drainage (surface and subsurface) must be provided to lower the water table in saline soils
→ The saline soil have a pH less than 8.5
→ The sodium percentage less than 15
→ The natural soil pH is 7

Alkaline Soils: The alkaline soils have pH greater than 8.5

→ Sodium percentage is greater than 15

→ If the salt efflorescence continues for a longer period, a base exchange reaction with clay take place thus sodiumizing the clay, making it impermeable, illaerated and highly unproductive. Such soil are called alkaline soils.

→ The electrical conductivity usually less than 4 mmhos/cm

→ The colour of the alkaline soil is black

Part (C)

How do you reclaim salt affected lands?

In the arid regions of the world and along coastal areas subject to periodic inundation by sea water, soils may have such high content of soluble salts that production of economical plants is not possible. The salts found in soils are generally the chlorides, carbonates, bicarbonates and sulfates of sodium, with lesser amounts of potassium, magnesium and calcium salts.

→ $NaCl$ least harmful

→ Na_2SO_4 medium harmful

→ Na_2CO_3 most harmful

→ The above salts are soluble in water
→ When WT rises up or roots are in capillary zone, the GW moves upwords and salts are deposited in root zone and surface of soil

Reclamation of salt affected lands. How to avoid afforescence?

- By maintaining the water table sufficiently below the roots
- Hence all the measures which we were suggested for preventing water logging hold good for preventing salinity of lands
- An afficent drainage (Surface and subsurface) must be provided to lower the water table in saline soils.

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 crop like rice are grown on leached land for 1 or 2 seasons.

QNo (2)
Part (a)

Explain the procedure of designing of an Irrigation canal by Kennedy's theorey

Ans

Kennedy procedure for canal design

Step 1:

Assume the trial value of D and put in equation 1 and determine

$V_o = 0.546 m D^{0.64}$

Step 2:

In equation 1: $Q = AV$

$A = Q/V$

$A = BD + D^2/2$

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

For assumed D determine B

Find $R = A/P$

Step 3:

Substitute the value of R in eqn 2 (Kutters and Chazys Equation) to obtain V which will be the actual velocity for assumed dimensions.

Step 4:

If the velocity worked out from Equation 2 agrees with that of obtained with the equation 3 (Kennedeys equation). Then the assumed depth is correct. Other wise repeat the procedure with changed value of D.

Part (b)

Design an irrigation channel by Kennedy's theorey to carry a discharge of 30 cumecs with CVR (m) of 1 and N as 0.0225 and bed slope of 1 in 5000, Assume the depth (D) as 2.3m.

silt particles of 0.56 mm.

Solution

Given Data.

Discharge (Q) = 30 m³/sec

Cvr (m) = 1

N = 0.0225

Bed slope = 1 in 5000

Depth (D) = 2.3m

Solution

Finding velocity

By formula

$V_K = 0.546 m D^{0.64}$

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

$V_K = 0.930 m$

⇒ Now calculating Area of canal

By formula

⇒ $Q = AV$

⇒ $A = Q/V$

$A = 30/0.930$

Area $= 32.25 m^2$

⇒ Now we have to calculate B. By using formula

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

$BD + 0.5D^2$

⇒ By putting values

$A = BD + 0.5D^2$

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

$32.25 - 2.645 = 2.3(B)$

$B = 12.87m$

⇒ Now we have to calculate wetted perimeter

So by formula

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

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

$P = 18.01m$

⇒ Now we have to calculate Hydralic Radius

$R = A/P$

$R = 32.25/18.01$ $R = 1.79m$

Now calculating mean velocity from chezy equation

$$V_c = C\,(RS)^{1/2}$$

Where

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

$$C \Rightarrow \frac{\frac{1}{0.0225} + \left(23 + \frac{0.00155}{(115000)}\right)}{1 + \left(23 + \frac{0.00155}{(115000)}\right) \times \left(\frac{0.0225}{\sqrt{1.79}}\right)}$$

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

$$\boxed{C = 49.56}$$

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

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

QNO (03)

Part (a)

Differentiate between initial regima and final regima and final regima in accordancy to laceys theorey.

Ans

Laceys Theorey:

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

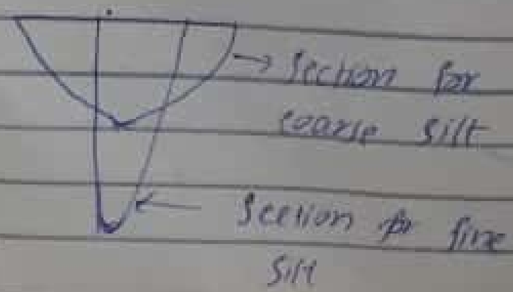
Initial Regime:

When only bed slope of channel changes but the cross section remains then also no silting or scouring take place. But this is rare.

Final Regime:

If all the parameters (perimeter depth and slope) have equally free to vary and adjust according to discharge and silt grades then the channels is said to have final regima.

→ In final regime the cross section assumes semi-ellipse shape



Part (b)

Design a regime channel by laceys theorey for discharge of 30 cumecs and mean diameters of silt particles of 0.56 mm

Given data:

$$Q = 30\ m^3/sec$$

$$m = 0.56 mm$$

Solution

$$\text{Silt factor} = f = 1.76 \times m^{0.5}$$

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

$$\boxed{f = 1.3}$$

$$V_m \left(\frac{Qf^2}{140}\right)^{1/6}$$

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

$$\boxed{V_m = 0.844}$$

$$Q = AV.$$

$$A = Q/V = \frac{30}{0.844}$$

$$\boxed{A = 35.54}$$

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$P = 4.75 \sqrt{Q}$

$P = 4.75 \sqrt{30}$

$\boxed{P = 26.01}$

$R = \frac{5}{2} \times \frac{V^2}{f}$

$R = \frac{5}{2} \times \frac{(0.844)^2}{1.3}$

$\boxed{R = 1.36}$

$A = BD + D^2/2$

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

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

$26.01 = B + 2.236D \rightarrow ②$

put eq ② in eq ①

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

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

$35.54 = 26.01D - 2.236D^2 + 0.5D^2$

$35.54 = 26.01D - 1.736D^2$

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

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

By Quadratic equation

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

$D = 1.52$ put in eq ②

$B = 26.01 - 2.236\ (1.52)$

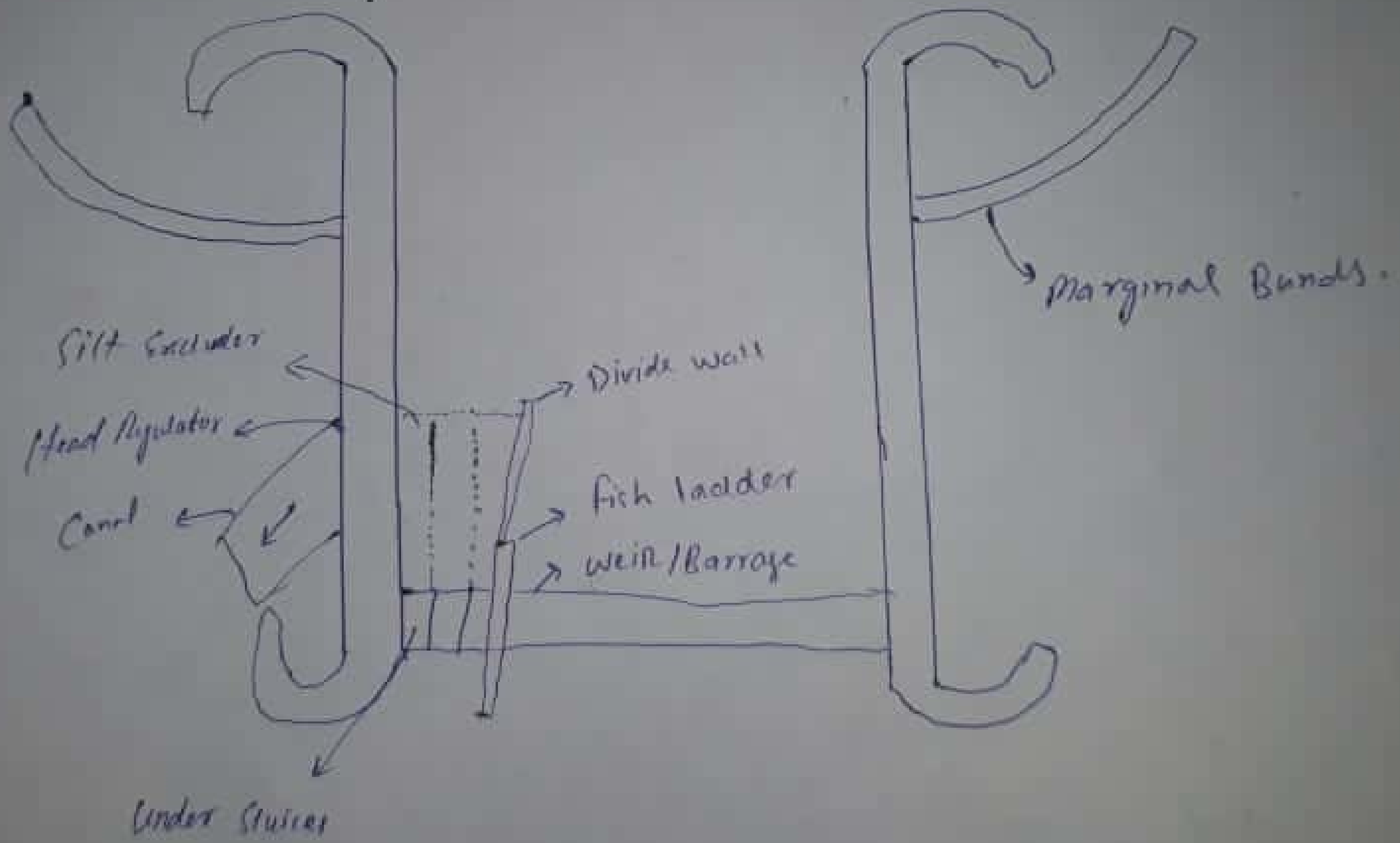
$\boxed{B = 22.611}$

$$S = \frac{P^{(5/3)}}{3340\ Q^{1/6}}$$

$\boxed{S = 0.00026}$

QNo4 A ⇒ Explain the Components of headwork with neat diagram.

Ans



Q.No (4)

Part (a)

Explain the components of headworks with neat diagram.

Ans

Introduction:

Any hydraulic structure which supplies water to the off taking canal is called a headwork. Headwork Headwork may be divided into two

(1) Storage head works: Dam is constructed across a river valley to form storage reservoir known as storage head works. Waters is supplied to the canal from this reservior through canal regulator. These serves for multipurpose function like hydro-electric power generation, flood control, fishery

(2) Diversion head works: Weir or barrage is constructed across a perennial river to raise water level and to divert the water to canal, is known as diversion head work. Flow of water in the canal is controlled by canal head regulator.

Objective of diversion head work: It raises the water level on its upstream side. It regulates the supply of water into canals. It creates a small pond (not reservoir) on its upstream and provides some pondage.

Site selection for diversion head work:

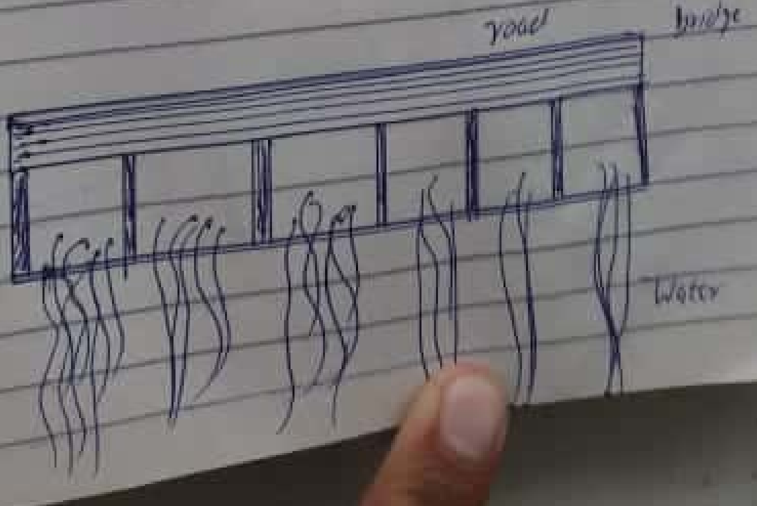
Section at the site should be narrow and well-defined. The river should have high, well-defined, in erodible and non-submersible banks so that the cost of river trainings works is minimum.

Components of a diversion headwork.

① Weir: 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 than the existing water level of the river.

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

③ Under sluices: Also known as scouring sluices. The under sluices are the opening provided at the base of the weir or barrage.



④ Divide wall :-

The divide wall is a long wall constructed or right angles in the weir or barrage, it may be constructed with stone masonry or cement concrete

Function of divide wall:-

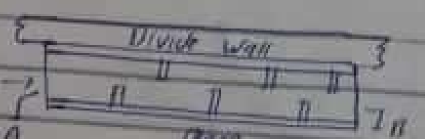
To form a still water pocket in front of the canal head so that the suspended silt can be settled down which then later be cleaned through the scouring sluices from time to time.

⑤ Fish ladder:-

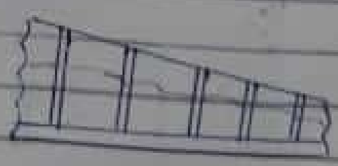
The fish ladder is provided just by the side of the devide wall for the free movement of fishes. Rivers are important source of fishes. The movement is essential for the survival

- In the fish ladder, the fable walls are constructed in a zigzag manner so that the velocity of flow within the ladder does not exceed 3 m/sec

- The width, length and height of the fish ladder depend on the nature of the river and the type of the weir or barrage



Plan



Section AB

Part (b)

What are the functions of head regulators?

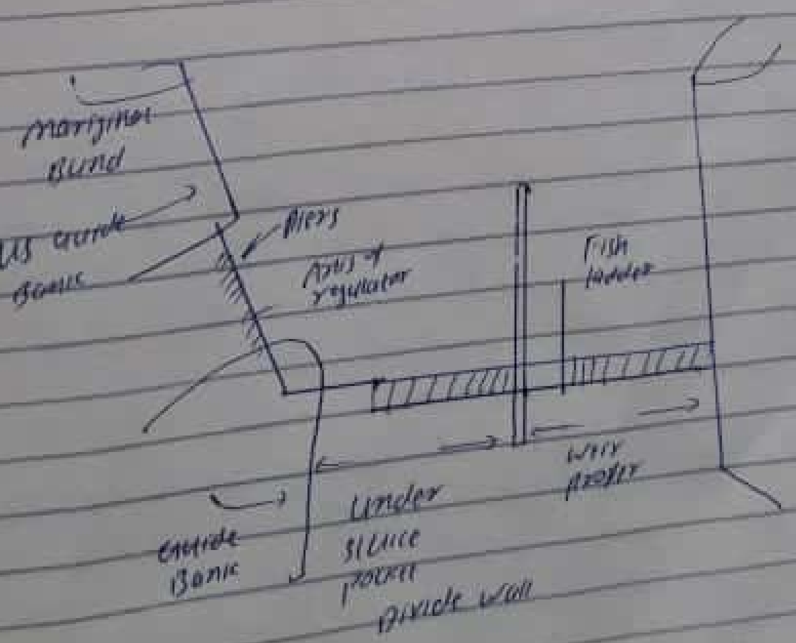
Ans

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

Function of canal head Regulator:

It regulates the supply of water entering the canal. It controls the entry of silt in the canal. It prevents the river-floods from entering the canal



Silt regulation works:-
The entry of silt into a canal, which takes off from a head works can be reduced by constructed certain special works called silt control works.

Types

① Silt Excluders:-
Silt excluders are those works which are constructed on the bed of the river upstream of the head regulator.

② Silt Ejectors:-
Silt ejectors also called silt extractors are those devices which extract the silt from the canal water after the silted water has travelled a certain distance in the off-take canal.

River training works:
River training works are required near the weir site in order to ensure a smooth and an axial flow of water, and thus to prevent the river from outflanking the works due to a change in its course.

Guide Bank:-
When a barrage is constructed across a river which flows through the alluvial soil, the guide banks must be constructed on both the approaches to protect the structure from erosion.

Marginal Bunds:-

The marginal bunds are earthen embankments which are constructed parallel to the river bank on one or both the banks according to the condition. The top width is generally 3 to 4 m. The side slope on the river side is generally 1.5 : 1 and that on the country side is 2:1.