AJAY KUMAR GARG ENGINEERING COLLEGE, GHAZIABAD
DEPARTMENT OF CIVIL ENGINEERING
Sessional Test–2(Solution)

Course: B.Tech.
Session: 2017-18
Subject: Water Resources Engineering
Max Marks: 50

Semester: VII
Section: CE-1& CE2
Sub. Code: NCE-702
Time:2 hours

Note: Answer all the sections. Any data if missing may be assumed suitably.

SECTION– A

Q1] a) What is duty and delta? Write the relationship between duty and delta in brief.

Ans:- Duty: The number of hectare of land which gets irrigated by a supply discharge of $1\ m^3/s$ continuously during the entire base period of crop for its full maturity.

Delta:- This is total water depth (cm) required by the crop during its base period to attain full maturity is called Delta of crop.

$$\Delta = \frac{8.64 \times B}{D} \text{ (in m)}$$

Where $\Delta \rightarrow$ Delta
$D \rightarrow$ Duty
$B \rightarrow$ Base period (in days)

Q1] b) Describe Alluvial and non alluvial canal.

Ans:- The soil which is formed by

transportation and deposition of silt through the agency of water, over a course of time is alluvial soil, & same soil if excavated and canal is made is called Alluvial soil.

Mountainous regions may go on disintegrating over a period of time resulting in formation of rocky plain area, the canal constructed using these rocks & soils are non alluvial soil.

Q1] c) Write the different loss in a canal.

Ans :- Losses of water in canals.

1) Evaporation :- Evaporation losses are generally of the order 2 to 3 % of total loss.

2) Seepage Loss :- These are of two types (a) percolation loss (b) Absorption loss

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Q1] d) What are different irrigation efficiencies ?

Ans :- There are various kinds of irrigation efficiencies :-

i) Efficiency of water conveyance :- Ratio of water delivered into field from outlet to water entering into channel at starting point. (η_c)

ii) Efficiency of water application :- Ratio of quantity of water stored into root zone of crop to quantity of water actually delivered. (η_a)

iii) Efficiency of water storage :- Ratio of water stored in root zone during irrigation to water needed in the

root zone prior to irrigation. (n_s)

IV) Efficiency of water use :- Ratio of water beneficially used including leaching water to quantity of water delivered. n_u

Q1] e) What is the mechanism of sediment transport describe in brief.

Ans :- The basic mechanism behind the phenomenon of sediment transport is the drag force exerted by water in the direction of flow, on the channel bed. This force is nothing but a pull of water on wetted area, called Tractive force (or) Drag force.

SECTION - B

Q2] a) Compare Lacey's theory and Keneddy Theory.

Ans :-

LACEY'S THEORY	KENEDDY THEORY
1) Lacey accounted eddies generated both from base and sides of channel.	1) Keneddy neglected eddies.
2) Lacey differentiated Regime conditions i) Initial Regime ii) True Regime iii) Final Regime	2) Keneddy stated that all the channels are in regime if they do not silt or scour.

3) A suitable mathematical relationship was given for silt factor. $f = 1.76\sqrt{d_{mm}}$	3) No such relation was given for CVR and silt grade.
4) Lacey gave own eqn for calculation of Bed slope $S = \frac{f^{5/3}}{3340\, Q^{1/6}}$	4) No such expression was given by Kenedy.
5) Lacey provided relation for actual velocity of flow $V = \left(\frac{Qf^2}{140}\right)^{1/6}$	5) Kenedy used Manning's or Chezy's eqn for velocity.

Q2] b) Using Lacey's theory, design the irrigation canal with following data.

Full supply discharge = 10 cumecs

Mean diameter of silt particle = 0.33 mm

Side slope $\frac{1}{2}:1$

Find also the bed slope of channel.

Sol.

$Q = 10\ m^3/s$ $\quad f = 1.76\sqrt{d_{mm}}$

$= 1.011$

$$V = \left(\frac{Qf^2}{140}\right)^{1/6} = \frac{(10 \times 1.011^2)^{1/6}}{140^{1/6}} = 0.6465\ m/s$$

$$\text{Area } A = \frac{Q}{V} = 15.467\ m^2$$

$$P = 4.75\sqrt{Q} = 15.02\ m$$

For a Trapezoidal section channel

$\frac{1}{2}H:1V$ slopes

$P = b + \sqrt{5}\,y$ and

$A = \left(b + \frac{y}{2}\right)y$

$b + y\sqrt{5} = 15.02$ — (I)

$by + \frac{y^2}{2} = 15.467$ — (II)

From (I) and (II) $b = 12.348$ m

$y = 1.1947$ m

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

$= \frac{1}{4813.87}$

Ans:- Design of Irrigation Channel

1) Depth of flow — 1.19 m
2) Base width — 12.348 m
3) Trapezoidal Section ; Bed Slope $\frac{1}{4813}$

Q2] C) Root zone of an irrigation soil has dry unit weight of 15 KN/m^3 and field capacity of 30%. The root zone depth of certain crop having permanent wilting point 8% is 0.8m, Find

i) Depth of moisture in root zone at FC.
ii) Depth of moisture in root zone at permanent wilting point and depth of water available.

Sol. Available Moisture = 30 − 8

= 22 %.

Readily available moisture = 0.8 × 22%

= 17.6%.

∴ Optimum Moisture = 30 − 17.6

= 12.4%.

i) Depth of water stored

$$= \frac{\gamma_d}{\gamma_w} d (FC - OMC)$$

$$= \frac{13}{9.8} \times 0.8 \left(.30 - \frac{12.4}{100}\right)$$

$$= 0.1867 \text{ m} = \boxed{18.67 \text{ cm}} \quad [\text{Ans}]$$

ii) Depth of water in root zone at PWP

$$= \frac{\gamma_d}{\gamma_w} \times d \times (FC - PWP)$$

$$= \frac{13}{9.8} \times 0.8 (.30 - 0.08)$$

$$= 0.2334 \text{ m} = \boxed{23.34 \text{ cm}} \quad [\text{Ans}]$$

Q2) d) What is the problem of Water logging ? What are the poor effects of water logging ? Describe some suitable remedial measures against water logging in brief.

Ans :- An agricultural land is said to be water logged when its productivity gets affected by high water table.

Effect of water logging :-

(i) Water logging leads to salinity of soil.

(ii) Promotes weed growth which harms growth of crops.

(iii) Normal cultivation operations like ploughing etc are hard to perform.

Certain possible remedial measures are-

1) Lining of canal and water courses.
2) Reducing the Intensity of irrigation.
3) By introducing crop rotation.
4) By providing Intercepting drains.
5) By adopting consumptive use of surface and sub surface water.

Q2] e) What is canal lining? What are the advantages of canal lining?

Ans:- By lining the canal, we mean that the earthen surface of channel is lined with stable lining surface, such as concrete, tiles, asphalt etc.

Advantages of Canal Lining :-

1) Seepage control. Seepage losses are considerably reduce with lining.
2) Prevention of Water-logging :- Uncontrolled seepage is prevented, rise in water table is seen.
3) Increase in channel capacity :- Lining increases channel capacity by reducing the losses.
4) Increase in Command Area.
5) Reduction in maintenance cost.
6) Elimination of flood danger.

SECTION – C

Q3] a) The following data pertains to healthy growth of crop :-

i) Field capacity of soil = 30%

ii) Permanent wilting percentage = 11%

iii) Density of soil = 1300 kg/m^3

iv) Effective depth of Root zone = 700 mm

v) Daily consumptive use of water for given crop = 12 mm

For healthy growth, moisture content must not fall below 25% of water holding capacity between field capacity and PWP. Determine the watering intervals in days.

Sol. Max. water holding capacity of soil

= FC – PWP = 30 – 11 = 19%

25% of max holding capacity = 4.75%

Lower limit at which m.c can be allowed to fall = 4.75% + 11%.

= 15.75%

The m.c. can be allowed to vary between 30% and 15.75%

Water depth stored between these two limits

$= \frac{\gamma_d}{w}$ (30% – 15.75%)

$= \frac{1300}{1000}(0.7)^{1.5}(0.30 - 0.1575)$

$= 0.1297 = 12.97$ cm

Since consumptive use is 12 mm/day

∴ 12.97 cm of water will be consumed in

$= \frac{1}{12} \times (12.97 \times 10)$

$= 10.8$ days

Ans :- The watering should, therefore be applied after every 10 days

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Q3) b] A sandy loam soil holds water at 140 mm/m between field capacity and permanent wilting point. The root depth of crop is 30cm and allowable depletion of water is 35%. The daily water use by crop is 5mm/day. The area is 60 hectare and water can be diverted at 28 lps. The surface irrigation application efficiency is 40%.

Determine ; i) Allowable depletion depth between irrigation

ii) Frequency of Irrigation

iii) Net application depth of water.
iv) Volume of water required.
v) Time to irrigate 4 hectare plot.

Sol.:- Moisture holding capacity of soil = 140 mm/m
Depth of root zone = 0.3 m
∴ Moisture holding capacity of root zone
$= 140 \frac{mm}{m} \times 0.3\ m = 42\ mm = 4.2\ cm$
Allowable depletion = 35%

i) Available moisture depth b/w irrigation
= 35% of 4.2 cm = 1.47 cm [Ans]

ii) Frequency of Irrigation = $\frac{1.47\ cm}{0.5\ cm/day} = 2.94$ days
say 3 days [Ans]

iii) Net water depth to be applied while irrigating each time after 3 days
$= 3 \times 0.5 = 1.5$ cm (Ans)

$$FIR = \frac{\text{Net irrigation requirement}}{\text{Efficiency of irrigation}} = \frac{1.5}{0.4}$$
$$= 3.75\ cm$$

iv) ∴ Quantity of water required in fields
$= 3.75\ cm \times \text{area} = 3.75 \times 60\ ha = 22,500\ m^3$

[Ans] Volume of water required to irrigate 60 ha area = 22,500 m^3 at interval of 3 days.

v) Time to irrigate 4 ha when irrigation water is supplied @ 28 lps

$$= \frac{3.75m \times 4\ ha \times 10^3\ l}{28\ lps} = \frac{(150\ m^3) \times 10^3\ l}{28\ lps}$$
$$= 14.88\ hr$$
[Ans]