

Canal Irrigation Sediment Transport and Canal Design

- Q.1** The Lacey's silt factor for a particular alluvium is 2.0. This alluvium would comprise
(a) medium sand of size 0.5 mm
(b) coarse sand of size 0.75 mm
(c) medium bajri of size 1.3 mm
(d) coarse bajri of size 2.4 mm
- Q.2** What is the regime scour depth for a channel in soil with silt factor of unity and carrying $8 \text{ m}^3/\text{s}/\text{m}$ of discharge intensity in accordance with Lacey's regime theory?
(a) 3.6 m (b) 4 m
(c) 5.4 m (d) 25.6 m
- Q.3** A channel designed by Lacey's theory has a mean velocity of one m/s. The silt factor is unity. The hydraulic mean radius will be
(a) 2.5 m (b) 2 m
(c) 1 m (d) 0.5 m
- Q.4** Consider the following statements:
1. Garret's diagram is used for the design of stable channels.
2. It is based on Lacey's theory and Manning's formula.
Out of these, the correct statement(s) is/are:
(a) Only 1 (b) Only 2
(c) 1 and 2 (d) Neither 1 nor 2
- Q.5** If it is required to design a stable channel for a given discharge in an alluvial material of known medium size. It can be done by least number of assumptions concerning the important variables by using
(a) Continuity equation and Kutter's equation
(b) Kennedy's equation and Chezy formula
(c) Lacey's regime equation
(d) Kennedy's formula along with Manning's formula
- Q.6** The Garret's diagram have been drawn up for a trapezoidal channel with side slopes as
(a) $1/2 \text{ H} : 1 \text{ V}$ ($1/2 : 1$)
(b) $1/3 \text{ H} : 1 \text{ V}$ ($1/3 : 1$)
(c) $5/8 \text{ H} : 1 \text{ V}$ ($5/8 : 1$)
(d) $1/4 \text{ H} : 1 \text{ V}$ ($1/4 : 1$)
- Q.7** Select the correct statement pertaining to a regime channel
(a) The Lacey's regime equations are inapplicable wherever the silt concentration is materially different from 500 ppm.
(b) The Lacey's equation are applicable to all unlined irrigation canals in India and Pakistan.
(c) If the silt factor is much smaller than unity, then Lacey's equation are not applicable.
(d) Lacey's equation are applicable to all canals, lined or unlined, provided the silt charge is of the order of 500 ppm.
- Q.8** Two irrigation channels M and N are designed using Lacey's theory. If the mean diameter of the silt particles are the same for both the channels, and if the discharge in channel M is 50% greater than at N, then among these two channels
(a) channel N has smaller longitudinal slope.
(b) channel M has smaller longitudinal slope.
(c) channel M has smaller hydraulic radius.
(d) channel N has larger wetted perimeter.
- Q.9** The mean velocity in a Lacey's regime channel is proportional to
(a) $f^{1/2}$ (b) f
(c) Q (d) $Q^{1/3}$
- Q.10** Match List-I with List-II and select the correct answer using the codes given below the lists:
List-I
A. Lane's theory
B. Lacey's theory
C. Rouse's equation
D. Richard's equation
List-II
1. Unsteady, unsaturated flow in a porous medium
2. Uplift pressures
3. Suspended sediment concentration in the vertical direction
4. Regime canals
Codes:

	A	B	C	D
(a)	2	4	3	1
(b)	4	2	3	1
(c)	2	4	1	3
(d)	1	4	2	3
- Q.11** Shield's criteria for the initiation of motion states that the entrainment function $[U_* / g d (G - 1)]$ is a unique function of
(a) Reynold's number
(b) (Froude number)/(Shear Reynold's number)
(c) Froude number
(d) Shear Reynold's number
- Q.12** The minimum size of sediment that may remain stable in an alluvial channel, carrying discharge intensity q , with hydraulic radius R , and bottom slope S , is
(a) 11 RS (b) $1.35 \left(\frac{q^2}{g} \right)^{1/2}$
(c) $\gamma \text{ RS}$ (d) None of them
- Q.13** The most important shape parameter in sediment analysis is
(a) sphericity (b) shape factor
(c) roundness (d) form factor
- Q.14** Lacey's regime theory is not applicable to a canal in
(a) true regime (b) initial regime
(c) final regime (d) None of them
- Q.15** The bed of an alluvial channel along the flow will always be
(a) flat
(b) wavy
(c) duned and rippled
(d) all of the above are possible
- Q.16** Consider the following statements:
1. Silt is kept in suspension because of the generation of eddies.
2. According to Kennedy, the eddies are generated from the wetted perimeter of the canal.
Which of the above statements is/are correct?
(a) Only 1 (b) Only 2
(c) 1 and 2 (d) Neither 1 nor 2
- Q.17** Lacey, in his regime equations, has adjusted his silt factor to be unity for the standard silt used by Kennedy. It is known that Kennedy used Bari-Doab alluvium as the standard silt in his equation. Then, the mean size, in mm, of Bari-Doab alluvium and the critical velocity ratio for this silt are, respectively.
(a) 0.32 and 1.00 (b) 1.0 and 1.0
(c) 1.0 and 1.76 (d) 0.57 and 0.90
- Q.18** The total number of independent equations that form the Lacey's regime theory is
(a) 6 (b) 10
(c) 3 (d) 4
- Q.19** The velocity of flow in the channel with a depth of 1 m, calculated by Kennedy's theory with a critical velocity ratio as 1.2 is
(a) 0.50 m/s (b) 0.55 m/s
(c) 0.66 m/s (d) 0.70 m/s
- Q.20** Lacey's scour depth equation is given by
(a) $1.85 \left(\frac{q}{f} \right)^{1/3}$ (b) $1.35 \left(\frac{q^2}{f} \right)^{1/3}$
(c) $1.35 \left(\frac{q}{f} \right)^{1/6}$ (d) $1.85 \left(\frac{q^2}{f} \right)^{1/3}$

Q.21 A channel aligned nearly parallel to the natural drainage of an area is called

- (a) Side slope channel
- (b) Contour channel
- (c) Water shed channel
- (d) Ridge channel

Q.22 The water requirement of crop is maximum during

- (a) first watering before sowing the crop
- (b) first watering when the crop has grown a few centimetres
- (c) last watering before harvesting
- (d) intermediate watering between (b) and (c)

Q.23 Which of the following are correct about Regime channels?

- 1. Discharge in the channel is constant.
 - 2. Sediment load is constant.
 - 3. Channel perimeter varies.
 - 4. Sediment grade is constant.
 - 5. Sediment comprises loose granular material.
- (a) 1, 2, 3 and 5 (b) 2, 3 and 4
(c) 1, 3, 4 and 5 (d) 1, 2 and 4

Q.24 If discharge through a river is $4000 \text{ m}^3/\text{s}$ then its perimeter as per Lacey's theory is likely to be

- (a) 360 m
- (b) 300 m
- (c) 150 m
- (d) 240 m

Q.25 The maximum tractive stress on channel sides is given by

- (a) $\gamma_w RS$
- (b) $1.1 RS$
- (c) $0.75 \gamma_w RS$
- (d) None of these

Q.26 The critical velocity ratio in Kennedy's critical velocity equation takes into account the effect of

- (a) roughness of bed.
- (b) slope of the channel.

- (c) size and type of silt.
- (d) cross-section of channel.

Q.27 Manning's rugosity coefficient is proportional to

- (a) d
- (b) $d^{1/3}$
- (c) $d^{1/6}$
- (d) $d^{1/2}$

Q.28 Assertion (A): The tractive force method of designing stable channel in non-cohesive soils is applicable only when the channels carry clear water.

Reason (R): In cohesionless soils, channels are designed only for non-scouring.

- (a) both A and R are true and R is the correct explanation of A
- (b) both A and R are true but R is not a correct explanation of A
- (c) A is true but R is false
- (d) A is false but R is true

Q.29 I. A channel in which all variables are equally free to vary has a tendency to assume trapezoidal section.

- II. For very fine silt, the section is semicircle.
- III. Channels in coarser silt is deeper compared to channels in finer silt.

Which of the following statement/s is/are correct?

- (a) Only I
- (b) Only II
- (c) II and III
- (d) I and II

Q.30 According to Lacey

- (a) $S \propto \frac{f^{5/3}}{Q^{1/3}}$
- (b) $S \propto \frac{q^{1/3}}{f^{5/3}}$
- (c) $S \propto \frac{f^{3/5}}{Q^{2/3}}$
- (d) $S \propto \frac{f^{1/3}}{Q^{5/3}}$

Answers Canal Irrigation Sediment Transport and Canal Design

1. (c) 2. (b) 3. (a) 4. (a) 5. (c) 6. (a) 7. (a) 8. (b) 9. (d) 10. (a)
11. (d) 12. (c) 13. (a) 14. (b) 15. (d) 16. (a) 17. (a) 18. (c) 19. (c) 20. (b)
21. (a) 22. (b) 23. (d) 24. (b) 25. (c) 26. (c) 27. (c) 28. (a) 29. (b) 30. (a)

Explanations Canal Irrigation Sediment Transport and Canal Design

1. (c)

$$f = 1.76 \sqrt{d_{mm}}$$

$$\Rightarrow 2 = 1.76 \sqrt{d_{mm}}$$

$$\Rightarrow d_{mm} = 1.291 \text{ mm} \approx 1.30 \text{ mm}$$

3. (a)

$$R = \frac{5 \left(\frac{v^2}{f} \right)}{2 \left(\frac{f^2}{1} \right)} = 2.5 \text{ m}$$

4. (a)

Garret's diagram is based on Kennedy's theory and Manning's formula.

6. (a)

Garret's diagram have been drawn for trapezoidal channel with side slope as 1/2 H : 1 V.

8. (b)

In Lacey's Theory
Bed slope 'S' is given by

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

$$Q_M = 1.5 Q, Q_N = Q$$

$f \rightarrow$ same for both channels

$$\therefore \frac{S_M}{S_N} = \left(\frac{Q_N}{Q_M} \right)^{1/6}$$

$$\therefore \frac{S_M}{S_N} = \left(\frac{Q}{1.5 Q} \right)^{1/6}$$

$$\frac{S_M}{S_N} = \left(\frac{1}{1.5} \right)^{1/6}$$

So longitudinal slope of channel M is smaller.

9. (d)

In Lacey's regime channel mean velocity V is given by

$$V = \left[\frac{Q f^2}{140} \right]^{1/6} \text{ m/sec}$$

$$\therefore V \propto Q^{1/6}$$

11. (d)

Shield's entrainment function $\tau_{*c} [g \times d \times (G-1)]$ is a function of shear Reynold's number at critical stage of bed movement & based on experimental work. In shields diagram if shear Reynold's number is greater than 400, critical shear stress is independent of it.

17. (a)

$$d_{mm} = \left(\frac{1}{1.76} \right)^2 = 0.323$$

Critical velocity,

$$V = 0.55 m D^{0.64}$$

$$0.267 = 0.55 m (0.323)^{0.64}$$

$$\Rightarrow m = 1$$

18. (c)

$$f = 1.76 \sqrt{d}$$

$$V_c = \sqrt{\frac{2}{5} f R}$$

$$A f^2 = 140 V_c^5$$

are the basic independent equations given by Lacey.

19. (c)

$$V = 0.55 m D^{0.64}$$

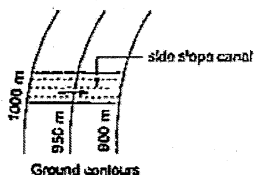
$$= 0.55 \times 1.2 \times 10^{0.64}$$

$$= 0.66 \text{ m/s}$$

21. (a)

A side slope canal is that which is aligned at right angles to the contours i.e., along the side slopes as shown in figure. Since such a channel runs parallel to the natural drainage flow, it usually does not intercept drainage channels.

Example:



Alignment of side slope canal

Hence option (a) is correct.

22. (b)

The first watering after sowing the crop when the crop is few centimeter high is known as kor watering. This irrigation depth is maximum of all the watering depth and is called kor depth.

The period during which kor watering is applied from the instant of sowing the crop is called kor period.

Hence option (b) is correct.

24. (b)

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

$$= 4.75\sqrt{4000}$$

$$= 300.4 \approx 300 \text{ m}$$

27. (c)

By Strickler's formula

$$N = \frac{1}{24} d^{1/6}$$

30. (a)

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

This regime slope formula given by Lacey, gives excessive slope values. Not even a single channel has been constructed according to this regime slope equation, either on the lower Chenab canal system or on lower Bari Doab canal system. The rigidity of this regime slope equation was therefore, later changed by Lacey to the form

$$S \propto \frac{f^{5/3}}{Q^{1/3}}$$

which was his final form, showing no rigidity of the constants.