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CE 181501

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17/2/22 2021

B.Tech. 5<sup>th</sup> Semester End-Term Examination

CE

OPEN CHANNEL FLOW AND IRRIGATION ENGINEERING

(New Regulation & New Syllabus)

Full Marks – 70

Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer Question No.1 and any five from the rest.

1. Choose the correct answer (10 × 1 = 10)
- (i) If B is the base period in days, D is the duty in hectares/cumec and  $\Delta$  is the delta of the crop in m, the relation between them is given by
- (a)  $D = 8.64B\Delta$  (b)  $\Delta = 8.64BD$
- (c)  $\Delta = \frac{0.864B}{D}$  (d)  $\Delta = \frac{8.64B}{D}$
- (ii) Net irrigation requirement of a crop is given by
- (a) Consumptive use + field losses
- (b) Consumptive use + conveyance losses
- (c) Consumptive use + field losses + conveyance losses
- (d) Consumptive use — effective rainfall
- (iii) The divide wall in a diversion headwork is provided
- (a) To increase the head of flow through the head regulator
- (b) To prevent the formation of vortices in front of head regulator
- (c) To control the silt entry into channel
- (d) To reduce the uplift pressure on the apron

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- (iv) If  $Q$  is the discharge, the wetted perimeter of a regime channel according to Lacey's theory is given by
- (a)  $P = 47.5\sqrt{Q}$  (b)  $P = 475\sqrt{Q}$   
(c)  $P = 0.475\sqrt{Q}$  (d)  $P = 4.75\sqrt{Q}$
- (v) The difference in elevations of top of bank and full supply level of a canal is called
- (a) Berm (b) Critical depth  
(c) Free board (d) Surcharge depth
- (vi) Total Energy Line (T.E.L.) represents the sum of
- (a) Pressure head and kinetic head  
(b) Datum head and kinetic head  
(c) Pressure head and datum head  
(d) Pressure head, kinetic head and datum head
- (vii) Specific energy of a flowing fluid per unit weight is
- (a)  $P/W + v^2/g$  (b)  $P/W + v/2g$   
(c)  $v^2/2g + h$  (d)  $P/W + v^2/2g + h$
- (viii) For medium silt whose average grain size is 0.16 mm, Lacey's silt factor is likely to be
- (a) 0.35 (b) 0.70  
(c) 1.35 (d) 1.70
- (ix) The two depth corresponding to same specific energy is called
- (a) Critical depth (b) Alternate depth  
(c) Normal depth (d) Conjugate depth
- (x) Which of the following is back water profile
- (a)  $M_1$  and  $M_3$  profile (b)  $S_1$  and  $S_3$  profile  
(c)  $C_1$  and  $C_3$  profile (d) All the above



2. (a) Show that for critical flow condition in a channel (6)

$$E_c = (2/3) h_c$$

where,  $h_c$  = Critical depth

$E_c$  = Specific energy at critical flow.

Also show that the critical depth ' $h_c$ ' is related to alternate depth  $h_1$  and  $h_2$  in a rectangular channel by the equation

$$h_c^3 = \frac{2h_1^2 h_2^2}{h_1 + h_2} h_c^3$$

- (b) A trapezoidal channel 10.0 m wide and having a side slope of 1.5H: 1V is laid on a slope of 0.0020. The roughness coefficient  $n=0.015$ . Find the normal depth for a discharge of  $42 \text{ m}^3/\text{sec}$  through the channel. (6)
3. (a) Classify Hydraulic Jump based on upstream Froude's number. (4)
- (b) A hydraulic jump occurs in a rectangular channel of width 8.0 m. The depth of flow before and after the jump are 1.10 m and 3.60 m respectively. The flow rate is  $80 \text{ m}^3/\text{sec}$ . Calculate the critical depth, loss of energy, length of jump and efficiency of jump. (8)
4. (a) State the assumptions required for deducing the dynamic equation for steady gradually varied flow in open channel. Deduce the dynamic equation of gradually varied flow. (6)
- (b) A rectangular channel 6.0 m wide discharges at a depth of 3.0 m with bed slope 1 in 5000 and Manning's  $n = 0.015$ . A small weir placed across the channel raises the depth to 6.50 m just upstream of the weir. How far upstream of the weir, depth becomes 4.0 m? Solve the problem by single step. (6)
5. (a) Assuming width of channel as ' $b$ ' and depth of flow as ' $y$ ', find the conditions for most economic trapezoidal channel section. (4)
- (b) Design an irrigation canal through an alluvial soil carrying a discharge of  $40 \text{ m}^3/\text{sec}$  by Lacey's silt theory. Assume mean dia. of bed material as 0.34mm side slope 1.5H : 1V. Provide necessary free board. (8)

6. (a) What is meant by "Duty" and "Delta" of canal water? Derive a relationship a relationship between duty and delta for a given base period. (6)
- (b) Explain with the help of a neat sketch, the various component parts along with their functions of a diversion headwork. (6)
7. (a) Describe various types of cross-drainage works with the help of necessary sketches. Write a note on selection of suitable type of cross-drainage works. (6)
- (b) Design a tube well for the following data (6)
- (i) Yield required = 0.35 cumec
  - (ii) Thickness of confined aquifer = 55 m
  - (iii) Radius of circle of influence = 320 m
  - (iv) Permeability coefficient = 60 m/day
  - (v) Drawdown = 6 m.
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