Code : 011725

B.Tech 7th Semester Exam., 2020

DESIGN OF HYDRAULIC STRUCTURE

Time : 3 hours *Full Marks* : 70

Instructions :

(i) All questions carry equal marks.

(ii) There are ***NINE*** *questions in this paper.*

(iii) Attempt ***FIVE*** *questions in all.*

(iv) Question No. ***1*** *is compulsory.*

1. Choose the correct option (any *seven*) :

(a) For a triangular dam section of height H for just no tension under the action of water pressure, self-weight and uplift pressure, the minimum base width required with usual notation is

(i) $\frac{H}{S-1}$

(ii) $\frac{H}{(S-1)^2}$

(iii) $H = \frac{f}{W\sqrt{(S-C+1)}}$

(iv) $\frac{H}{\sqrt{S-1}}$

(b) Outlets which maintain a constant discharge irrespective of the fluctuations in the water level of supply channel and water course are known as

(i) non-modular outlets

(ii) rigid modules

(iii) semi-modular outlets

(iv) Kennedy's gauge outlets

(c) The rate of seepage through an earth dam obtained from a flow net is given by (with usual notations)

(i) $q = Kh(N_d \times N_f)$

(ii) $q = Kh(N_d / N_f)$

(iii) $q = Kh(\sqrt{N_f / N_d})$

(iv) $q = Kh(N_f / N_d)$

(d) According to Khosla's theory for a hydraulic structure built on pervious foundation, a cutoff is quite essential at

(i) the upstream end

(ii) the mid-section

(iii) some intermediate sections

(iv) the downstream end

(e) The undersluices in a diversion headwork are provided with a crest level

(i) same as the rest of the weir

(ii) lower than the rest of the weir

(iii) higher than the rest of the weir

(iv) same as the crest of the head regulator

(f) According to Khosla's theory, exit gradient is given by (with usual notation)

(i) $G_E = \frac{H}{d}\frac{1}{\pi\sqrt{\lambda}}$

(ii) $G_E = \frac{H}{d}\pi\sqrt{\lambda}$

(iii) $G_E = \frac{d}{H}\frac{1}{\pi\sqrt{\lambda}}$

(iv) $G_E = \frac{d}{H}\pi\sqrt{\lambda}$

(g) Gibbs' module is a type of an outlet which

(i) ensures a constant discharge irrespective of the fluctuations in the water level of supply channel and water course

(ii) ensures a constant discharge irrespective of the fluctuations in the water level of water course

(iii) does not ensure constant discharge irrespective of the fluctuations in water level of supply channel and water course

(iv) ensures a constant discharge irrespective of the fluctuations in the water level of supply channel

(h) The structure which serves the purpose of a safety valve for a canal is

(i) canal escape

(ii) cross regulator

(iii) head regulator

(iv) canal fall

(i) Lining of irrigation channels

(i) increases the possibility of area to be waterlogged

(ii) does not affect the phenomenon of waterlogging

(iii) is an effective anti-waterlogging measure

(iv) increases the maintenance cost of the channels

(j) In Mitra's method of design of channel transitions, the depth of flow is assumed to be

(i) varying in the transitions and the trough

(ii) varying only in the contraction transition

(iii) varying only in the expansion transition

(iv) constant in the transitions as well as in the trough

2. Illustrate the following with the help of neat sketches :

   (a) Investigate the effect of shifting the floor relative to a barrier on uplift pressure, and comment on corresponding floor thickness.

   (b) Investigate the effect of upstream and downstream sheet piles (individually and combined) on the design of impervious floor of hydraulic structures.

   (c) Give relevance, significance and design of notch canal fall.

3. Determine afflux in syphon aqueduct for the data given below :

   (i) Diameter of the barrel (single) = 3 m

   (ii) Length of the barrel = 90 m

   (iii) Discharge through the barrel = 25 cumecs

   (iv) Friction factor (in Darcy-Weisbach formula) = 0·013

   (v) Coefficient of bend (2 bends) = 0·10

   (vi) Coefficient of head loss in expansion at outlet = 0·20

   (vii) Coefficient of head loss in contraction at inlet = 0·10

   Neglect velocity head in drainage channel.

4. What is meant by river basin development? Give different aspects, scope and some case studies for river basin development.

5. Following particulars were recorded from a barrage site :

   (i) Maximum reservoir level = 212 m

   (ii) Pond level = 211 m

   (iii) Downstream high flood level = 210 m

   (iv) Maximum design discharge = 3500 cumecs

   (v) Crest level of the barrage = 207 m

   (vi) Crest level of the head regulator = 208 m

   (vii) Coefficient of discharge = $2 \cdot 10\,m^{\frac{1}{2}}/s$ for barrage; $1 \cdot 50\,m^{\frac{1}{2}}/s$ for head regulator

   (viii) River bed level = 205 m

   (ix) Design discharge for main canal = 500 cumecs

   Determine the number of gates required for barrage and head regulator if each gate has 10 m clear span.

   Neglect end contractions due to piers and abutments and velocity head.

6. *(a)* Find the expressions for stresses (normal, principal and shear) developed in the elementary profile of a gravity dam.

   (b) Sketch uplift pressure at the base of a gravity dam, when *(i)* there is no drainage gallery and no tail water depth; *(ii)* there is drainage gallery and no tail water depth; *(iii)* both drainage gallery and tail water are present.

7. Describe with neat sketches various methods adopted for controlling seepage through the body of the dam and through foundation.

8. Following data were obtained from the stability analysis of a concrete gravity dam :

   (i) Total overturning moment about toe $= 1 \times 10^5$ t-m

   (ii) Total resisting moment about toe $= 2 \times 10^5$ t-m

   (iii) Total vertical force about base = 5000 t

   (iv) Base width of dam = 50 m

   (v) Slope of the d/s face = 0·8 H:1V

   Calculate the maximum and minimum vertical stress to which the foundation will be subjected to. What is the maximum principal stress at toe (assume no tail water)?

9. Design a cross regulator and a head regulator for a distributary channel taking off from the parent channel for the following data :

   Discharge of the parent channel = 100 cumecs

   Discharge of the distributary = 15 cumecs

   FSL of the parent channel = u/s 208·10
   d/s 207·90

   Bed width of parent channel = u/s 42 m; d/s 38 m

   Full supply water depth in the parent channel = u/s 2·5 m; d/s 2·5 m

   FSL of distributary = 207·10 m

   Bed width of distributary = 15 m

   Full depth of water in the distributary = 1·5 m

   Permissible Khosla's safe exit gradient = 1/6

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