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# CS/B.Tech (CE)/SEM-7/CE-705/2011-12 2011 HYDRAULIC STRUCTURE

Time Allotted: 3 Hours Full Marks: 70

The figures in the margin indicate full marks.

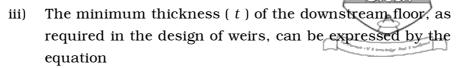
Candidates are required to give their answers in their own words as far as practicable.

#### **GROUP - A**

#### (Multiple Choice Type Questions)

- 1. Choose the correct alternatives for any ten of the following:  $10 \times 1 = 10$ 
  - i) Khosla's safe exit gradient for design of weirs will be lowest for the soil type
    - a) fine sand
- b) coarse sand
- c) shingle and gravels
- d) none of these.
- ii) The critical exit gradient as applicable to barrages is expressed by
  - a) w(1-n)(G-1), where w is unit weight of water, m = porosity of soil, G = sp. gr. of soil grain
  - b)  $H/dX \frac{1}{\pi\sqrt{\lambda}}$  where H, d and  $\lambda$  have their usual meaning
  - c)  $\frac{\text{safe exit gradient}}{\text{factor of safety}}$
  - d) none of these.

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a) 
$$\frac{h}{G+1}$$

b) 
$$\frac{h}{G-1}$$

c) 
$$\frac{h-t}{G-1}$$

d) 
$$1.33 \left(\frac{h}{G-1}\right)$$
.

iv) A weir consists of 32 m long horizontal floor with two sheet piles of 6 m and 8 m depth at the upstream and downstream ends of the floor respectively. Under an impounded depth of 4 m above the floor and with no tail water, the uplift pressure head at the mid-point of the floor by Bligh's creep theory is

- a) 2.50 m
- b) 2·13 m

c) 2.00 m

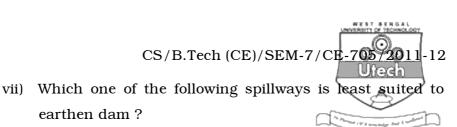
d) 1.87 m.

v) A cross drainage work is termed as a syphon if it carries the canal

- a) above the drainage with the drainage flowing under pressure
- b) below the drainage with the canal flowing under pressure
- c) below the drainage with the canal flowing at atmospheric pressure under the works
- d) above the drainage with the drainage flowing at atmospheric pressure under the works.

vi) The 'Safety Valve' of a dam is its

- a) drainage gallery
- b) inspection gallery
- c) spillway
- d) outlet sluices.



- a) Ogee spillway
- b) Side channel spillway
- c) Chute spillway
- d) Shaft spillway.
- viii) Hydraulic jump is widely used for dissipation of energy in
  - a) Ogee spillway
  - b) Trough spillway
  - c) Side channel spillway
  - d) All of these.
- ix) The discharge passing over an ogee spillway, per unit length of its apex line, is proportional to
  - a) *H*

b)  $H^2$ 

c)  $H^{1/2}$ 

- d)  $H^{3/2}$ .
- x) Which one of the following sets is used to control the seepage through the foundation of an earthendam?
  - a) Chimney drain, upstream blanket and cut-off trench
  - b) Cut-off shut piles, upstream blanket and cut-off trench
  - c) Upstream blanket, cut-off sheet piles and chimney drains
  - d) Relief well, upstream blanket and chimney drain.

- xi) A coffer dam is
  - a) a kind of gravity dam



- b) an earthen dam of small height built to protect important areas
- c) a temporary structure constructed to exclude water from the work area during construction
- d) an embankment built along a river to regulate the river.
- xii) Canal drops are required to
  - a) dissipate excess energy
  - b) dissipate inadequate land slope
  - c) dissipate excess land slope
  - d) none of these.

### **GROUP - B**

# (Short Answer Type Questions)

Answer any three of the following.

 $3 \times 5 = 15$ 

- 2. Write down the possible causes of failure of an earthen dam.
- 3. Explain Khosla's theory and concept of flownet.
- 4. Explain the fundamental difference between Khosla's theory and Bligh's creep theory for seepage below a weir on permeable foundation.
- 5. What are the differences between siphon aqueduct and canal siphon?
- 6. Discuss energy dissipation in hydraulic jump.

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- 7. Explain any *two* of the following:
  - a) Piping in earthen dams
  - b) Grout curtain
  - c) Relief wells
  - d) Inverted filter.

#### **GROUP - C**

# (Long Answer Type Questions)

Answer any *three* of the following.  $3 \times 15 = 45$ 

- 8. a) Discuss Bligh's criteria for design of impervious floor of weir for sub-surface flow.
  - b) An weir is constructed to withstand water 4.5 m deep.

    The floor length is 25 m with sheet piles 5 m and 8 m

    deep at either end. The weir is erected at a distance of
    6 m on the upstream end of the floor. Find using Bligh's

    theory the uplift pressures at 6 m, 12 m and 18 m from

    the upstream end of the floor and find thickness of the

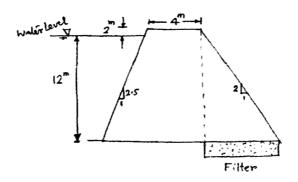
    floor at those points.

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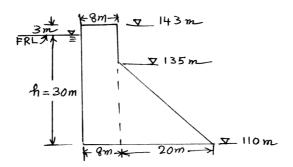
- 9. a) What is meant by canal regulation? What are the types of canal regulation works?
  - b) Distinguish between head regulator and cross regulators. Give the functions of head regulator and cross regulator.
- 10. a) When are canal falls necessary ? Give the considerations for location of canal falls.
  - b) Discuss any two of the following types of the canal falls:  $2\times 4\frac{1}{2}$ 
    - i) Ogee fall
    - ii) Stepped fall
    - iii) Sarda type fall
    - iv) Stepped glacis fall.
- 11. a) Write the conditions for drawing the flownet diagram and also derive the expression for seepage flow. 3+3

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b) A section of a homogeneous earthen dam is shown in following figure. Calculate the seepage discharge per metre length through the body of the dam.  $K=8\times10^{-5}$  m/sec.



12.



The following particulars refer to a concrete gravity dam resting over a rocky foundation as given in the above figure.

- i) RL of top of dam = 143.00 m
- ii) Free board = 3 m
- iii) Upstream face vertical
- iv) Downstream face sloped at 0.8(H): 1(V) from RL 135.00 m up to base.
- v) RL of base ( foundation ) 110.00 m
- vi) Top width 8 m.

Determine the stability of the dam and the stress induced when the reservoir is full. Neglect all other forces except hydrostatic thrust, uplift and self weight. Take unit weight of concrete as 2300 kg/m³, unit weight of water as 1000 kg/m³,  $\mu_{safe}$  = 0·7,  $f_{permissible}$  = 20 kg/cm² and bearing capacity = 15 kg/cm².

- 13. a) With a sketch, explain what is a 'rock toe' in earthen dams.
  - b) Explain briefly Khosla's exit gradient concept on the design of weirs on permeable foundation.
  - c) With a sketch, explain what is a 'chimney drain' in earthen dams.

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