(viii) The factor that does not try to destabilise a masonry gravity dam is
    (a) water seeping below the foundation of the dam
    (b) generation of waves by high winds
    (c) deposition of silt in dead storage zone of reservoir
    (d) water standing against the downstream face of the dam.

(ix) Factor of safety against overturning should be
    (a) <1.5   (b) >1.5   (c) 1   (d) 1-1.5.

(x) The dams that are often called as spillways
    (a) overflow dams   (b) diversion dams
    (c) non-overflow dams   (d) rigid dams.

Group – B

2. (a) The head regulator of a canal has 3 openings each 3 m wide. The water is flowing between the upper and lower gates. The vertical opening of the gate is 1 m. The head on the regulator is 0.45 m (Afflux). If the upstream water level rises by 0.20 m, find how much the upper gate must be lowered to maintain the canal discharge unaltered.

  (b) Differentiate between a weir and a barrage.

                                        9 + 3 = 12

3. (a) Write short note on River training works.

  (b) Draw and explain with diagram various types of diversion weirs.

                                        4 + 8 = 12

Group – C

4. (a) Explain Lane's weighted creep theory. How does it differ from the Bligh's creep theory of seepage flow?

  (b) Define streamlines, equipotential lines, critical exit gradient and safe exit gradient.

                                        8 + 4 = 12

5. The figure shows the section of a weir on permeable foundation. Calculate the average hydraulic gradient according to Bligh's creep theory, Lane's weighted creep theory. Also find the uplift pressure at points A, B and C as shown in figure and the floor thickness requires at these points. Locate the point where the required floor thickness is same from both the theories.


12
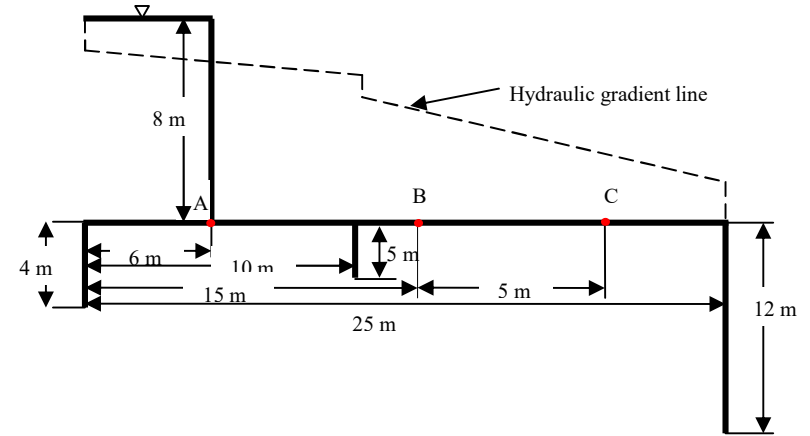
Group – D

6. (a) Classify dam based on function; hydraulic design; materials used for construction. Explain them briefly.

  (b) What are the various factors that govern the selection site of a dam?

                                        9 + 3 = 12

7. (a) Describe briefly the causes of failure of earthen dam with neat sketches.

  (b) An earthen dam made of homogenous material has the following data.
    Level of top of dam = 200 m
    Level of deepest riverbed = 190 m
    HFL of reservoir = 205 m
    Width of top of dam = 12 m
    Upstream slope = 2.5:1
    Downstream slope = 2:1
    Determine the phreatic line for this dam section and also the discharge through the dam.

   **4 + 8 = 12**

Group – E

8. The cross-section of a gravity dam is shown in figure. Examine the stability of this section at base when the reservoir is empty. Determine the principle stress at heel and toe, the shear stress at heel and toe for the following conditions:
(i) For reservoir empty and vertical earthquake forces acting downward

(ii) For reservoir empty and vertical earthquake forces acting upward

Assume, the unit weight of concrete 24 KN/m³ and unit weight of water 10 kN/m³. The earthquake forces may be taken as 0.2g for horizontal forces and 0.07g for vertical forces. The uplift may be taken as equal to hydrostatic pressure at either ends and is considered to act over 50% of the area of section.
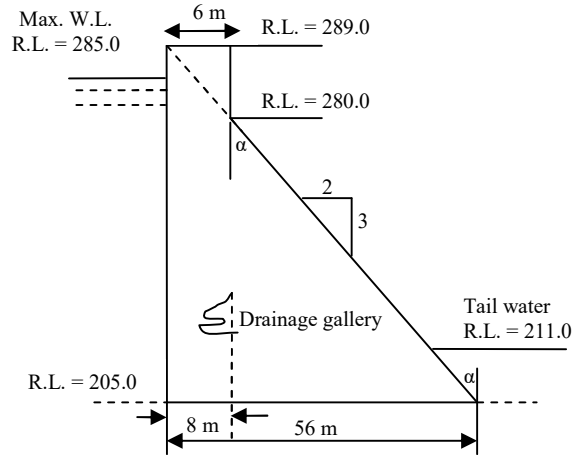
6 + 6 = 12

9. (a) Draw typical cross-section of concrete gravity dam. What do you mean by elementary profile of a gravity dam?

    (b) The figure shows the section of a gravity dam. Calculate the maximum vertical stresses at the heel and toe of the dam; the major principle stress at the toe of the dam; intensity of shear stress on a horizontal plane near the toe.
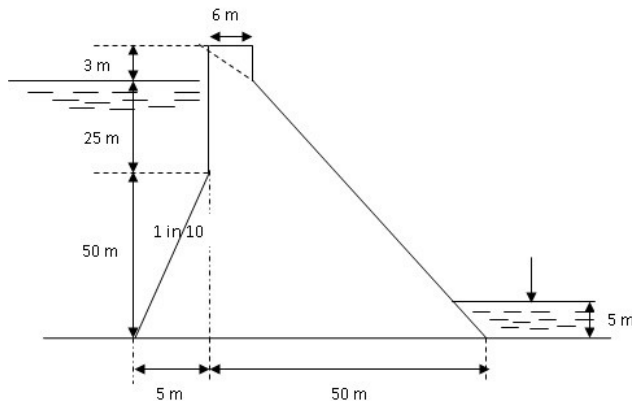
3 + 9 = 12

HYDRAULICS STRUCTURES
(CIVL 4144)

Time Allotted : 3 hrs   **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and
any 5 (five) from Group B to E, taking at least one from each group.

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

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

    (i)   The value of Khosla's critical exit gradient for usually met alluvial sandy soils of our country is about
           (a) 0   (b) ∞   (c) 1   (d) 0.25.

    (ii)   The backwater effect of weir is best called
           (a) retrogression   (b) backwater curve
           (c) afflux   (d) none of these.

    (iii) In a diversion headwork project, the canal head regulator is usually aligned
           (a) parallel to barrage axis   (b) perpendicular to the divide wall
           (c) parallel to the divide wall   (d) 45° to the divide wall.

    (iv)   The most preferred soil for the central impervious core of a zoned embankment type of an earthen dam is
           (a) highly impervious clay   (b) highly pervious gravel
           (c) coarse sand   (d) clay mixed with fine sand.

    (v)   The safety valve of a dam is its
           (a) drainage gallery   (b) spillway
           (c) inspection gallery   (d) outlet sluices.

    (vi)   When sand and gravel foundation strata is available at a proposed dam site of moderate height, the dam may be of the type
           (a) earthen dam or rockfill dam   (b) masonry gravity dam
           (c) double arch dam   (d) concrete gravity dam.

    (vii) Which one of the following spillway is best suited for earthen dams?
           (a) Ogee spillway   (b) Side channel spillway
           (c) Chute spillway   (d) Overfall spillway.