

**HYDRAULIC STRUCTURES
(CIVL 4241)**

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) According to Khosla's theory, the exit gradient in the absence of downstream cut-off is
(a) 1 (b) zero (c) infinity (d) very large.
- (ii) Silt excluders are constructed
(a) on river bed downstream of head regulator
(b) on river bed upstream of the head regulator
(c) on canal bed downstream of canal head regulator
(d) on canal bed upstream of canal head regulator.
- (iii) The Bligh's coefficient for light sand and mud is
(a) 10 (b) 20 (c) 18 (d) 25.
- (iv) 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.
- (v) The small openings made in the huge body of a concrete gravity dam such as sluices and inspection galleries can be assumed to be causing only local effects without any appreciable effect on the distribution of stresses as per the principle
(a) Laplace (b) St. Venant (c) Reynold (d) St. Francis.
- (vi) Presence of tail-water in a gravity dam _____
(a) increases the principal stress and decreases the shear stress
(b) increases both the principal stress and the shear stress
(c) decreases the principal stress and increases the shear stress
(d) decreases both the principal stress and the shear stress.
- (vii) Which of the following spillway is least suitable for an earthen dam?
(a) Ogee Spillway (b) Chute Spillway
(c) Shaft Spillway (d) Side channel Spillway.

- (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) The undersluices in a diversion headwork are provided with a crest level
(a) Same as the rest of the weir
(b) Lower than the rest of the weir
(c) Higher than the rest of the weir
(d) Same as the crest of canal regulator.
- (x) The maximum permissible eccentricity for no tension at the base of a gravity dam is
(a) $B/2$ (b) $B/3$ (c) $B/4$ (d) $B/6$.

Group – B

2. (a) Mention at least three effects for construction of weir or barrages on a river regime. [(CO3)(Understand/LOCQ)]
(b) Draw and explain with diagram various types of diversion weirs. [(CO1)(Remember/LOCQ)]
4 + 8 = 12
3. (a) Differentiate between a weir and a barrage with the help of neat sketches. [(CO2)(Remember/LOCQ)]
(b) Draw a typical layout of diversion head-works, indicating the various components of the system and write their functions. [(CO1)(Remember/LOCQ)]
4 + 8 = 12

Group – C

4. (a) What are the causes of failures of hydraulic structures on permeable foundations and what remedies are suggested to prevent them? [(CO2)(Remember/LOCQ)]
(b) Explain briefly Khosla's exit gradient concept. [(CO5)(Understand/IOCQ)]
8 + 4 = 12
5. (a) What is meant by piping in a hydraulic structure? [(CO1)(Understand/IOCQ)]
(b) The accompanying Fig. 1 shows the section of a hydraulic structure on permeable foundation. Calculate the average hydraulic gradient according to Bligh's creep theory and Lane's weighted creep theory. Also find the uplift pressures at point A, B and C as shown in fig. And also the floor thickness required at these points. Locate the points where both the required floor thickness is same, from both the theories. [(CO5)(Analyze/HOCQ)]

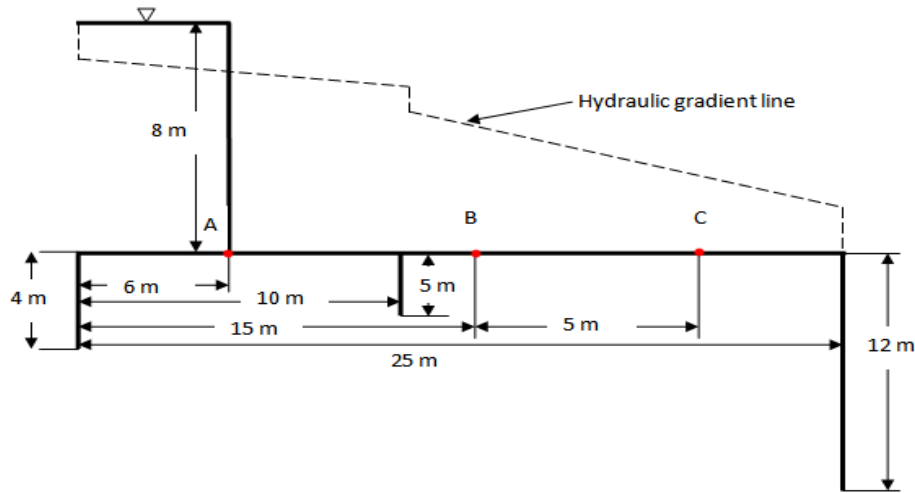


Fig. 1

$$2 + 10 = 12$$

Group – D

6. Write short note on: (i) Selection of dam site (ii) Advantages and disadvantages of dam construction. [[CO2](Remember/LOCQ)]
(6 + 6) = 12
7. (a) Write short note on homogenous and zoned type dams. [[CO1](Remember/LOCQ)]
- (b) An earthen dam made of homogenous material has the following data.
 Level of top of dam = 230m
 Level of deepest riverbed = 200m
 HFL of reservoir = 210m
 Width of top of dam = 12m
 Upstream slope = 5:1
 Downstream slope = 3:1
 Determine the phreatic line for this dam section and also the discharge through the dam. [[CO4](Analyse/HOCQ)]
5 + 7 = 12

Group – E

8. (a) Draw typical cross-section of a concrete gravity dam. Define the elementary profile of a gravity dam. [[CO3](Remember/LOCQ)]
- (b) A flow net is plotted for a homogenous earthen dam of height 22 m and freeboard 2 m. The results obtained are –
 Number of potential drops = 10
 Number of flow channels = 4
 The dam has a horizontal filter of 25 m length at the downstream end and coefficient of permeability is 5×10^{-4} cm/s. Calculate the discharge per m run of the dam. [[CO4](Analyse/HOCQ)]
(3 + 4) + 5 = 12

9. The cross-section of a gravity dam is shown in Fig. 2. Determine the maximum vertical stresses at heel and toe; the major principal stress at toe; the intensity of shear stress on a horizontal plane near the toe. Assume weight of concrete = 24 kN/m³.

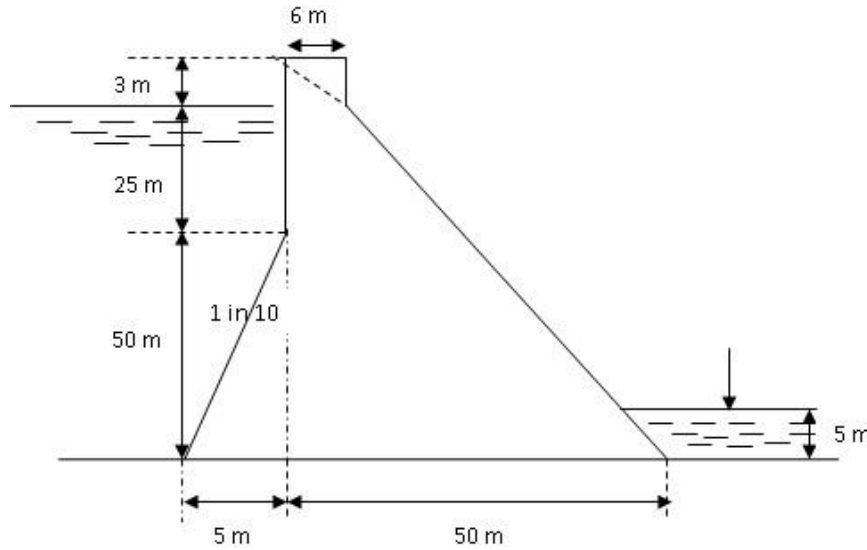


Fig. 2

[(CO6)(Analyse/HOCQ)]
(4 + 2 + 6) = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	58.33	6.25	35.42

Course Outcome (CO):

After the completion of the course students will be able to

1. Integrate hydraulics and water resources background by involving the students in water structures design applications.
2. Develop understanding of the basic principles and concepts of analysis and design of hydraulic structures.
3. Develop insight into the basic physical principles that govern the control of flows in hydraulic system.
4. Explain analytical and mathematical skills needed to describe and predict flow conditions in hydraulic structures.
5. Develop ability in students to effectively apply various principles and skills to the analysis and design of structures in hydraulic system.
6. Understand the fundamental concept, design and maintenance of hydraulic structures such as dams, diversion headworks etc.

*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question.