

Seat No.: _____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER-VIII(NEW) EXAMINATION – SUMMER 2019

Subject Code: 2184004

Date: 15/05/2019

Subject Name: Design of Hydraulic Structures

Time: 10:30 AM TO 01:00 PM

Total Marks: 70

Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- | | | MARKS |
|------------|---|-------|
| Q.1 | (a) Explain the term 'Cavitation' in Ogee spillway. | 03 |
| | (b) Discuss briefly the following points for the site selection of a concrete gravity dam: (i) Foundation; (ii) Topography; (iii) Site for spillway; (iv) Reservoir and catchment area | 04 |
| | (c) Fig 1 below shows the section of a gravity dam, compute:
(i) water pressure in horizontal and vertical directions;
(ii) Uplift Pressure;
(iii) Self-weight of the dam/m length.
Consider the density of concrete $\gamma_{\text{conc}} = 24 \text{ kN/m}^3$ and that of for water = 10 kN/m^3 . | 07 |

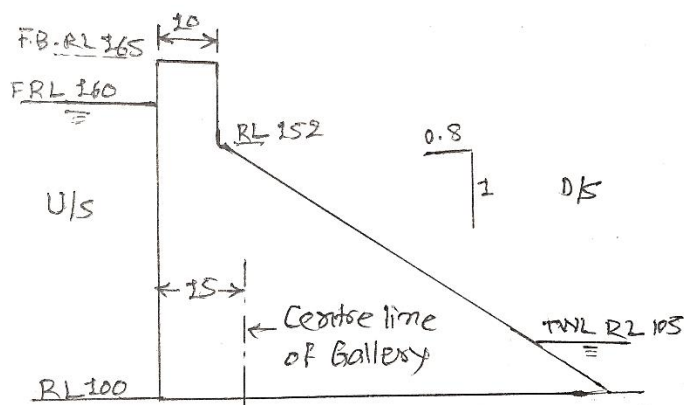


Fig. 1 Q.1(b) Figure NOT TO SCALE

- | | | |
|------------|---|----|
| Q.2 | (a) What is the phreatic line in an earthen dam? | 03 |
| | (b) State the different purposes of locating a phreatic line. | 04 |
| | (c) Find the coordinates of a phreatic line for an earth dam of homogeneous section without filter at d/s toe. The following data are to be considered for the dam:
(i) Top width of the dam = 8m
(ii) Free Board = 3m
(iii) Maximum head of water = 22m
(iv) Angle α (the side slope make with the horizontal) = 30°
(v) Correction factor for $\alpha = 30^\circ$ is $\Delta a / (a + \Delta a) = 0.36$
Also find the seepage discharge for the same section when permeability coefficient is known as $K = 4.2 \times 10^{-6} \text{ m/s}$. | 07 |
| | OR | |
| | (c) Check the stability of the d/s slope of an earth dam from the following data:
(i) Top width of the dam = 7.5m | 07 |

(ii) Maximum head of water = 22m

(iii) F. B. = 3m

(iv) u/s slope = 1:3 & d/s slope = 1:2.5

(v) Horizontal length of filter = 22m.

Assume the properties of soil for the dam as follows:

 (i) Average unit weight under steady seepage = 20 KN/m³

 (ii) Coefficient of permeability = 4.5×10^{-6} m/s

 (iii) Angle of internal friction between the soil particles $\phi = 25^\circ$ and average cohesion $C = 18$ KN/m².

 (iv) Density of water $\gamma_w = 10$ KN/m³.

Assume foundation of the dam to be impervious and friction between the consecutive sides of the slices is negligible. Take the area of N diagram $a_N = 12$ cm²; area of T diagram $a_T = 4.8$ cm² and that of pore water pressure diagram $a_U = 1.9$ cm². Consider the scale of the drawing as 1 cm = 5m and the angle subtended at the centre of rotation by arc $\delta = 48^\circ.6$. The radius of arc = 67.52 m. Whether this section is safe?

- Q.3** (a) State the different losses occurring in an unlined canal. **03**
 (b) State the step wise procedure for designing a trapezoidal section of a lined canal when Discharge, velocity, side slope or angle θ , Bed slope & Rugosity coefficient are known. **04**
 (c) Design a trapezoidal lined canal section for a discharge of 120 m³/s at a bed slope of 1/4200 and a side slope of 1:1.25 (V:H). **07**
 Given: Rugosity coefficient $N = 0.018$ & velocity = 1.5m/s

OR

- Q.3** (a) Explain the term 'Tractive force' related to the canal flow. **03**
 (b) Explain in detail the Bed load and Suspended load **04**
 (c) What is a synthetic unit hydrograph? **07**
 A synthetic unit hydrograph is to be developed for an ungauged catchment area for which there is no information of any kind. An adjoining catchment is thoroughly gauged. It has 3-h UH with a peak of 140m³/s appearing 37 h from the start of rainfall excess. Determine the Snyder's coefficients of the hydrograph to be used for the adjoining ungauged catchment for formulation of 3 h UH.

Area(A); Gauged catchment	2718 km²
Basin length along the river (l)	148 km
Centroid length (l_c) along the river.	76 km

- Q.4** (a) State the factors affecting the storm water flow. **03**
 (b) Explain the Rational method for estimation of storm water flow for sewer design. **04**
 (c) The drainage area of one sector of a town is 40 hectares. The classification of the surfaces of this area is as follows: **07**

Percentage of total surface area	Types of surface	Runoff coefficient
20	Hard pavement	0.86
25	Roof surface	0.82
15	Unpaved street	0.30
28	Garden & lawns	0.15
12	Wooded area	0.05

If the time of concentration for the area is 35 minutes, find the maximum runoff discharge. Use the Rational formula for finding the intensity of rainfall.

OR

- Q.4** (a) Define the terms: (i) ordinary floods and (ii) standard projected flood 03
 (b) Explain briefly the causes of flood and the term probable maximum flood. 04
 (c) State the procedure for the location of hydraulic jump formation of a sloping glacis weir and water height at that point for the known data of u/s TEL; d/s TEL; Head loss, H_L & discharge intensity q $m^3/s/m$. 07
- Q.5** (a) Explain the term Cross Drainage works. 07
 Classify the different CD works depending upon the relative levels and discharges.
 Explain briefly with neat sketch the 'syphon aqueduct'.
 (b) What is canal fluming? 07
 With the help of Mitra's hyperbolic method of canal transition, design the fluming portions of an aqueduct from the following data:
 (i) For Contraction Transition:
 Normal bed width of trapezoidal section of canal = $B_N = 24m$; and Flumed width, $B_F = 14m$; Splay = 1:2
 (ii) For Expansion Transition:
 Normal bed width of trapezoidal section at outlet = $B_N = 24m$; Flumed width, $B_F = 14m$; Splay = 1:3. Assume the depth of water remains same in the flumed portion. Length of fluming section L_f is to be found out in each transition.

OR

- Q.5** **Attempt : (Any Four)** 14
- (i) Differentiate between low & high concrete gravity dam.
 (ii) Functions of cross regulator and head regulator.
 (iii) List the design features of an ogee spillway and describe the procedure for locating the d/s profile of the same.
 (iv) Limitations of Bligh's creep theory.
 (v) Find the exit gradient for a weir founded on permeable soil having Bligh's coefficient, $C = 9$. Consider the structure as shown in Fig.2. Whether the structure remains safe against piping action?

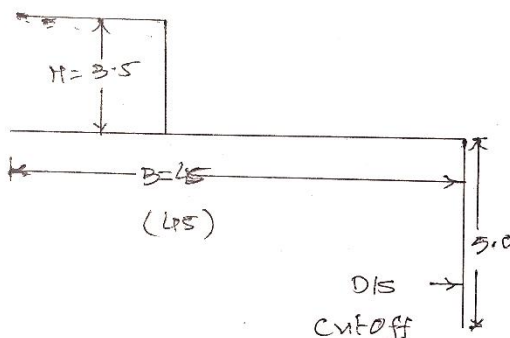


Fig.2 Q.5 OR (v)
 Figure NOT TO SCALE
 All dimensions are in 'meter'.
