01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2068 Bhadra

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE, B.Agri.	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Hydraulics

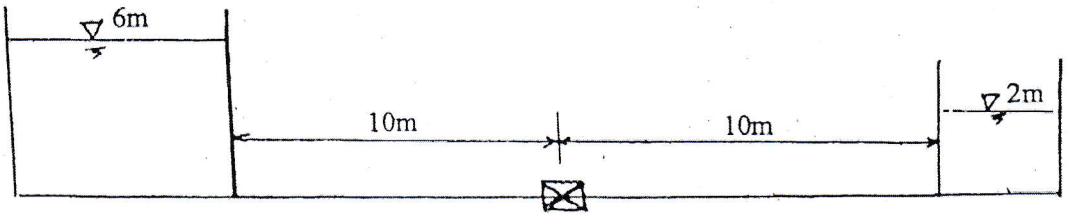
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Necessary figure is attached herewith.***
- ✓ *Assume suitable data if necessary.*

1. Explain Prandtl mixing length theory. Starting from the expression for turbulent shear stress derive the velocity distribution in the region of turbulent flow near hydrodynamically smooth boundaries in the form $\frac{u}{u^*} = 5.75\log_{10}\left(\frac{u^* y}{D}\right) + 5.5.$ [2+6]

2. What size of new cast iron pipe is needed to transport 400 lps of water for 1 km long pipe with 2m head loss? Take roughness height of the pipe is 0.26mm and the viscosity of water 0.0014 Pa.S. [8]

3. Reservoir A, water surface elevation 120m is connected to reservoir B and C having surface elevation 70m and 50m respectively. A pipe line 150mm diameter and 400m long connects reservoir A to Junction D: Reservoir B and C are connected to Junction D by 75mm diameter 100m long and 100mm diameter 250m long pipeline respectively. Assuming friction factor f = 0.04 for all pipes, estimate the rate of flow for each pipe, neglecting minor head losses. [10]

4. A 20m long, 75mm diameter, steel pipeline, wall thickness 6mm, carries water from a large reservoir tank, held at a constant head of 6m. Discharge is 0.022m3/s through a variable speed valve positioned 10m from the supply tank. Discharge is to a second constant head tank held at 2m head as shown in figure below. If the valve closure is instantaneous, determine the theoretical magnitudes of the pressure wave propagated away from the valve under frictionless conditions. Draw pressure (both steady and unsteady) time curve at point 5m, 2.5m and 0.5m from the upstream tank. Take K = 2×10^9 N/m^2 and E = 204×10^9 N/m^2. [8]



5. Differentiate gradually, rapidly and spatially varied flow with neat sketches and examples. What is energy slope? [3+1]

6. Find a expression for the theoretical depth for maximum velocity in a closed circular channel in terms of the diameter "d". Compare the discharge at maximum velocity with that when the channel is running full, assuming that the Chezy's coefficient is unaltered, and the pressure remains atmospheric. [5+2]

OR

Write algorithm and programme coding in any high level language (C or Fortran) for calculating uniform depth for rectangular channel. [2+5]

7. Draw and explain the velocity profile in a cross-section of rectangular, triangular and trapezoidal channel shapes. [3]

8. Why the critical depth varies for the constriction flow analysis and does not vary for the hump flow analysis? A rectangular channel 2m wide has a flow of 2.4 m^3/s at a depth of 1.0m. Determine if critical depth occurs (a) a section where a hump of ΔZ = 20cm high is installed across the channel bed, (b) a side wall constriction (with no humps) reducing the channel width to 1.7m, and (c) both the hump and side wall constrictions combined. Will the upstream depth be affected for case (c)? If so, to what extent? Neglect head losses of the hump and constriction caused by friction, expansion and contraction. [2+2+3+3+2]

9. A rectangular channel conveying a discharge of 30 m^3/sec is 12m wide with a bed slope 1 in 6000 and having Manning's n = 0.025. The depth of flow at a section is 1.5m. Find how far upstream or downstream of this section the depth of flow will be 2m. Find also the types of profile. Use direct step method for calculation and take only two steps for calculation. [7+1]

10. A wide channel with uniform rectangular section has a change of slope from 1 in 95 to 1 in 1420 and the flow is 3.75m^3/s per m width. Determine the normal depth of flow corresponding to each slope and show that a hydraulic jump will occur in the region of the junction. Calculate the height of the jump and sketch the surface profiles between the upstream and downstream regions of uniform flow. Manning's coefficient n = 0.013 and it may be assumed that the channel is wide in comparison with the depth of flow, so that the hydraulic mean depth is approximately equal to the depth of flow. [6]

OR

Find the pre jump and post jump heights of the hydraulic jump formed at the toe of the spillway. Neglect energy loss due to flow over spillway. [6]

Height of the crest above D/S bed level = 3m
Discharge = 80 m^3/s
Width of the canal = 10.0m
Head over the crest level = 2.47m

Explain the formation condition of repelled and submerged jump for the above flow condition.

11. A channel which is to carry 10 m^3/s through moderately rolling topography on a slope of 0.0016 is to be excavated in coarse alluvium with 50% of particles being 3cm or more in diameter. Assume that channel is to be unlined and of trapezoidal section. Find suitable value of base width and side slope. Take φ = 34° and K_2 (ratio between bed shear stress and critical shear stress) = 0.75. Use tractive force method. [6]

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