07 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Magh

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Hydraulics *(CE555)*

- ✓ 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 Moody's diagram is attached herewith.***
- ✓ *Assume suitable data if necessary.*

1. Explain Prandtl Mixing length theory. Show that the velocity distribution in pipe for turbulent flow is Logarithmic. Derive an expression of head loss to sudden expansion of pipe. [2+3+3]

2. Water from a main canal is siphoned to a branch canal over an embankment by means of a wrought iron pipe of 100 mm diameter. The length of the pipeline up to the summit is 30 m and the total length is 90 m. Water surface elevation in the branch canal is 10 m below that of main canal. [8]

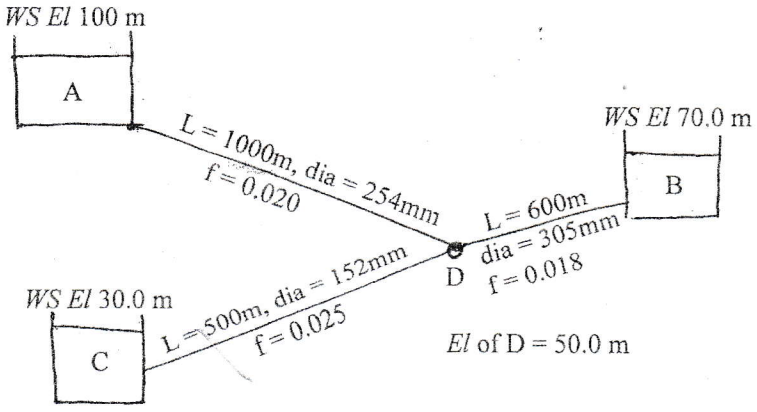
   a) If the total quantity of water required to be conveyed is 0.05 m^3/s, how many pipelines are needed?

   b) What is the maximum permissible height of the summit above the water level in the main canal so that the water pressure at the summit may not fall below 20 Kpa absolute, the barometer reading being 10 m of water?

   Take f = 0.025 and consider all losses.

3. a) Derive the expression of correction factor $\Delta Q = -\frac{\sum(rQ_0^2)}{\sum(2rQ_0)}$ for solution of pipe network using Hardy Cross method. Whether r is resistance coefficient of pipe and Q_0 is initial assumed discharge. [2]

   b) Determine the piezometric head at D for the following three reservoir problem. [8]



   Where, f is the friction factor of the Darcy-Weisbach equation used in Moody diagram.

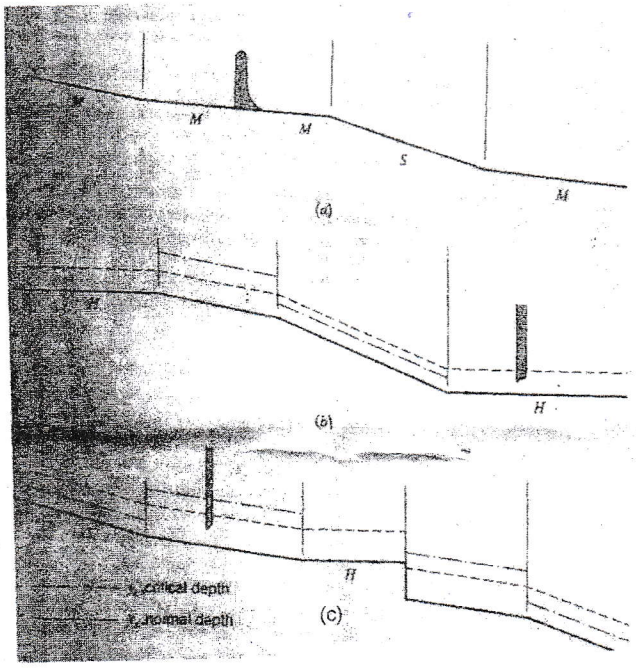
4. A steel pipeline (ϵ = 0.046 mm) 61 cm in diameter and 3.2 km long discharges freely at its lower end under a head of 61 m. What water-hammer pressure would develop if a valve at the outlet were closed in 4 sec? 60 sec? Wall thickness = 0.5 cm for both case of closure. Compute the stress that would develop in the walls of the pipe near the valve. If the working stress of steel is taken as 16,000 psi, what would be the minimum time of safe closure? Consider $E_{water} = 2.17 \times 10^9$ N/m^2 and $E_p = 1.9 \times 10^{11}$ N/m^2. [8]

5. Give the two practical examples of following flow regimes. [4]
   a) uniform and non-uniform flow
   b) spatially varied flow, gradually varied flow

6. Explain specific energy diagram and show that at minimum specific energy, the flow is critical. A rectangular channel 2 m wide has a flow of 2.4 m^3/s at a depth of 1.0 m. Determine if critical depth occurs (a) at the section where a hump of ΔZ = 20 cm high is installed across the bed, (b) a side wall constriction (no hump) reducing the channel width to 1.7 m, and (c) both the hump and side wall constriction 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. [6+2+2+2]

7. What are the conditions of uniform flow in open channel? A trapezoidal channel having side slope of 1:1 has to carry a flow of 15 m^3/s. The bed slope is 1 in 1000. Chezy's C is 45 if the channel is unlined and 70 if the channel is lined with concrete. The cost per m^3 of excavation is 3 times cost per m^2 of lining. Find which arrangement is economical. [2+8]

8. Sketch possible water surface profiles for the channel in figure below. First locate and mark the control points, then sketch the profiles, marking each profile with the appropriate designation. Show any hydraulic jumps that occur. [8]



9. The depth of uniform flow in a rectangular channel is 5 m wide (n = 0.02, S_0 = 0.04) is 0.5 m. A low dam raises the water depth of 2 m. Find whether a hydraulic jump takes place and if so at what distance upstream of the dam. [6]

10. A stream has a sediment bed of median size 0.35 mm. The slope of the channel is 1.5×10^{-4}. Stream is considered as trapezoidal with base width 3 m and side slope 1.5 H : 1 V. [6]
    a) If the depth of flow in the channel is 0.25 m, examine whether the bed particles will be in motion or not.
    b) Calculate minimum size of gravel that will not move in the bed of channel. Use empirical equation of critical shear stress as: $\tau_c(N/m^2) = 0.155 + \frac{0.409 d_{mm}^2}{(1+0.177 d_{mm}^2)^{1/2}}$.

***