TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2083 Baishakh

Exam.	Back (New Course)		
Level	BE	Full Marks	60
Programme	BCE	Pass Marks	24
Year / Part	II / II	Time	3 hrs.

Subject: - Hydraulics (*ENCE 251*)

- ✓ *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**.*
- ✓ *Assume suitable data if necessary.*

1. a) Prove that the shear stress distribution in the case of steady laminar flow for circular pipe is linear. What is Prandtl Mixing Length? [3+1]

   b) Reservoir 'A' water surface elevation 120 m is connected to reservoir B and C having surface elevation 70 m and 50 m respectively. A pipeline 150 mm diameter and 400 mm long connects reservoir 'A' to junction D. Reservoir B and C are connected to junction D by 75 mm diameter 100 m long and 100 mm diameter and 250 m long pipe line respectively. Assume friction factor f = 0.04 for all pipes, estimate the rate of flow for each pipe, neglecting minor head losses. [8]

2. a) Define Conveyance and Section factor (Uniform and critical flow). Derive the condition for hydraulically efficient side slopes for Trapezoidal channel. [2+4]

   b) A steel pipeline is 30 cm in diameter and has a wall thickness of 3 mm. The pipe is 1000 m long and conveys a flow of 100 Liter/sec (S = 0.82). The static head at the outlet is 160 m of oil. If the working stress of steel is 0.1KN/mm2, calculate the minimum time of closure of the downstream valve. For oil, $K = 10^9$ Pa and for steel $E = 2.14 \times 10^{11}$ pa. [6]

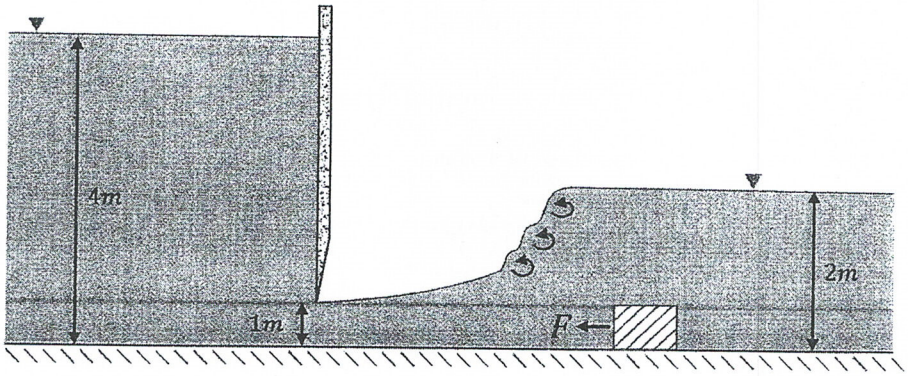
3. a) What is Rapidly Varied Flow? Classify the hydraulic jump based on Froude number and tail water depth. [1+3]

   b) A rectangular channel 8m wide and 1.5m deep has a slope of 1 in 1000 lined with smooth concrete plaster. It is desired to have the discharge to be maximum by changing the dimensions of the channel by keeping the same quantity of lining. Workout the new dimensions and the percentage increase in discharge. Assume n = 0.015. [8]

4. a) Write down the assumptions in derivation of GVF equation. Prove that the equation for wide rectangular channel is given by $\frac{dy}{dx} = \frac{\left(1-\left(\frac{y_n}{y}\right)^{10/3}\right)}{1-\left(\frac{y_c}{y}\right)^3}$, where y_n is normal depth and y_c is critical depth. [1+3]

   b) Water flows in a rectangular channel of 4 m width at a depth of 2.50 m and a velocity of 2.25 m/s. If the width of the channel is reduced to 2.50 m and the bed of the channel is raised by 0.20 m at a section, how will the level of water surface be affected? [8]

5. a) A sluice gate across a channel 5 m wide discharges a stream 1 m deep. What is the velocity of the flow releasing through the gate when the depth upstream of the sluice is 4 m? On the downstream side concrete blocks have been placed to create conditions for hydraulic jump to occur. Calculate the force on blocks if the downstream depth is 2 m. [6]



b) A rectangular channel of 4m width has a manning's roughness coefficient of 0.025. For a discharge of 6 m^3/s in this channel, identify the possible GVF profiles produced when bed slope changes from S_{01} = 0.0004 to S_{02} = 0.015. Find the length of GVF curve formed in S_{01} = 0.0004 using direct step method. Take three steps for solution. [6]

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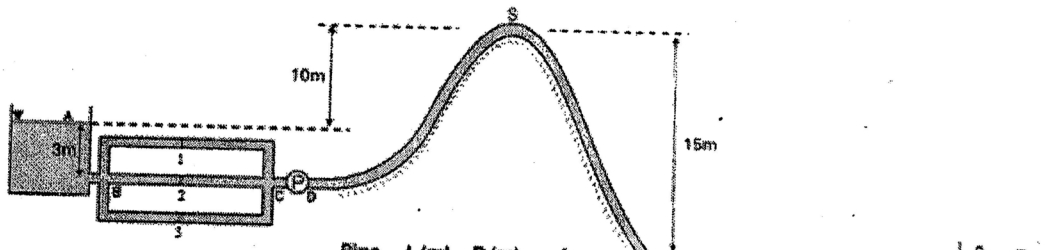
1. a) Derive an expression for the velocity distribution for steady laminar flow in a circular pipe. [4]

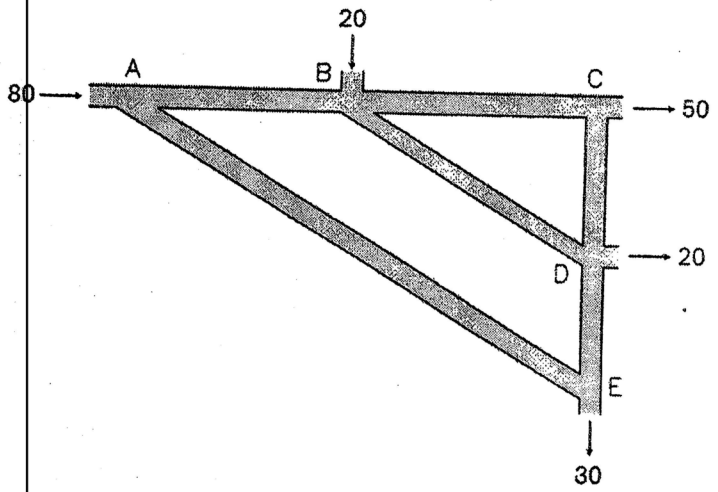
   b) A pipe network system is used to convey water from tank A to tank G located on the other side of the hill with the help of a siphon. A pump of capacity 5 kW with efficiency $\eta_p = 80\%$ is installed to pump the water through the siphon as shown in figure. Determine the discharge flowing through the siphon pipe and the pressure at the summit of the siphon. [5+3]



Pipe	L (m)	D (m)	f
BC_1	1000	0.3	0.02
BC_2	500	0.3	0.02
BC_3	1000	0.3	0.02
DS	500	0.5	0.02
SE	1500	0.5	0.02
EF_1	1000	0.3	0.02
EF_2	500	0.3	0.02
EF_3	1000	0.3	0.02

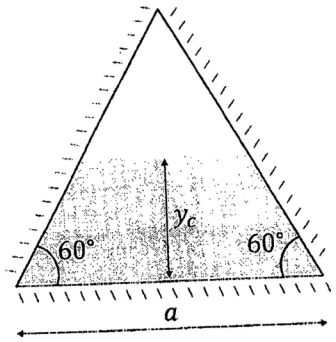
2. a) Water flowing in an elastic pipeline is brought to rest by instantaneous closure of valve. Explain, with illustration, how positive and negative waves are caused and travel along the pipeline (without considering head loss). Also, draw wave propagation chart at valve end if head losses are considered. [3+1]

   b) Solve discharges in each pipe of the following pipe network using hardy cross method (Consider two trials only) [8]



Pipe	L (m)	D (m)	f
AB	1000	1.0	0.02
BC	1000	1.0	0.02
CD	500	1.0	0.02
BD	1500	0.8	0.02
DE	500	1.0	0.02
AE	2000	0.8	0.02

3. a) Define alternate depths and critical depth with the help of specific energy diagram. Determine the critical depth y_c for a discharge Q passing through an equilateral triangular channel of side length a as shown in figure. [3+3]



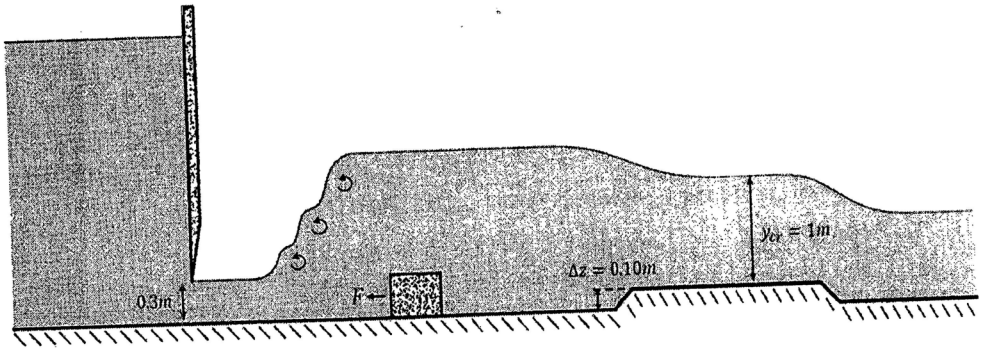
b) A trapezoidal canal with side slope of 2 horizontal to 1 vertical is to carry a discharge of 50 m^3/s. The canal is laid at a slope of 0.005 and the manning's roughness coefficient of the canal is n = 0.018. [3+3]

i) What should be the base width B of the canal to carry the given discharge at a uniform depth of 2 m?

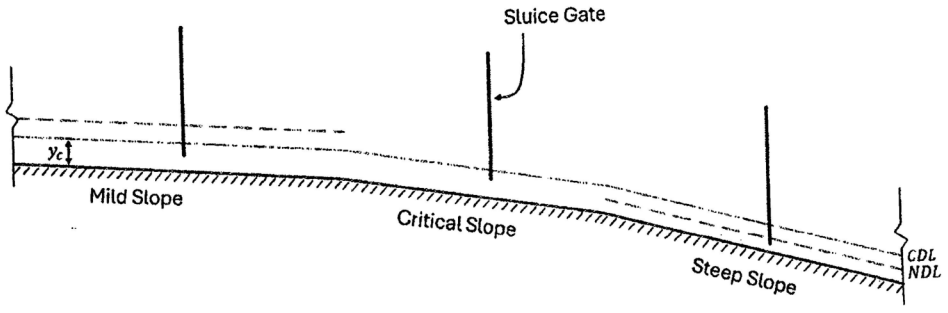
ii) If you want to redesign the channel section to be most economical cross section, what are the revised water depth y and base width B?

4. a) Derive an expression for momentum equation and sequent depth ratio for hydraulic jump in a rectangular channel with horizontal bed. [2+2]

b) A sluice gate across a wide rectangular channel discharges a stream 0.3 m deep. A jump is created just downstream of the gate with the help of concrete baffle blocks and the flow is passed through a broad crested weir where the flow is critical. Neglecting the losses except the one in the jump, determine the force provided by the blocks to the flow near the hydraulic jump and depth upstream of sluice gate. [8]



5. a) Derive an expression for governing equation or dynamic equation of gradually varied flow. Draw possible water surface for the following combinations. [2+2]



b) A sluice gate discharge 2 $m^3/s/m$ into a wide horizontal rectangular channel. The depth at the vena-contracta is 0.15 m. The tail water depth is 1.80 m. Assuming the channel to have a Manning's 'n' of 0.015, determine the location of the hydraulic jump. Use direct step method with three steps. [8]

OR

A rectangular channel 10 m wide is laid with a break in its bottom slope from 0.01 to 0.0064. If it carries discharge of 12.5 m^3/s per meter width, determine the nature of surface profile and compute its length. Use direct step computation method with $n = 0.015$. [8]

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