01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, B.Agri.	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 figures are attached herewith.*
- ✓ *Assume suitable data if necessary.*

1. a) One meter diameter pipe is to carry a water discharge of 1.0 m^3/s at the minimum loss of energy. What will be the permissible height of surface roughness? [8]

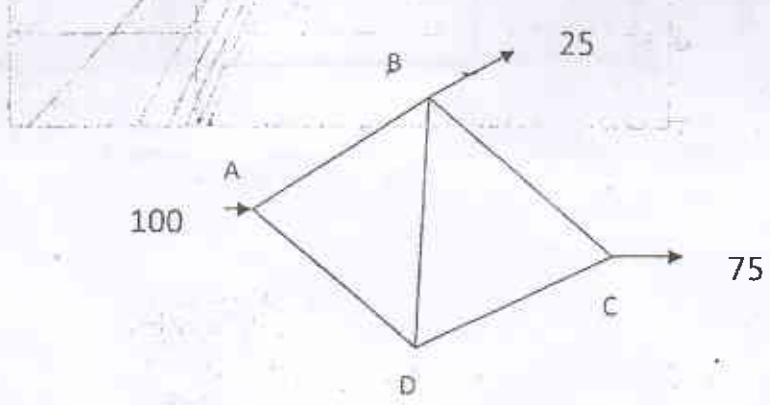
   b) Derive an expression for ratio of length of inlet to outlet leg for typical siphon as follows: [8]

$$\frac{l_1}{l_2} \le \frac{P_a - (Z_B - Z_A)}{(Z_B - Z_C) - P_a}$$

   Where P_a is atmospheric pressure, Z_A, Z_B, Z_C are elevation of inlet, summit and outlet of syphon.

2. a) A pump draws water from a reservoir and delivers it through a pipe 150 mm diameter, 90 m long, to a tank in which the free surface level is 8 m higher than that in the reservoir. The flow rate is steady at 0.05 m^3/s until a power failure causes the pump to stop. Neglecting minor losses in the pipe and in the pump and assuming that the pump stops instantaneously, determine for how long flow into bank continues after the power failure. The friction factor f may be taken as constant at 0.028 and elastic effects in the water or pipe material may be disregarded. [8]

   b) Using Hardy-cross method, find the rate of flow in every pipe lines as given below. The constant factor for AB, BC, CD, DA and BD are 1,2,1,2 and 3 respectively. [8]



3. a) A 900 mm diameter conduit 3600 m long is laid at a uniform slope of 1 in 1500 and connects two reservoirs. When the levels in the reservoirs are low, the conduit runs partly full and it is found that a normal depth of 600 mm gives a rate of flow of 0.322 m^3/s. The Chezy coefficient C is given by KR^n where K is a constant, R is the hydraulic radius and n = 1/6.

Neglecting losses of head at entry and exit, obtain (i) the value of K, (ii) the discharge when the conduit is flowing full and the difference in level between the two reservoirs is 4.5 m. [8]

b) A 3.5 m wide rectangular channel section carries 4 m^3/s of water at a depth of 1 m. If the width is to be reduced to 2.5 m and bed raised by 10 cm, what would be the depth of flow in the contracted section? What maximum rise in the bed level of the contracted section is possible without affecting the depth of flow upstream of the transition? [8]

4. a) A hydraulic jump is formed in a 4 m wide outlet just downstream of the control gate, which is located at the upstream end of the outlet. The flow depth upstream of the gate is 20 m. If the outlet discharge is 100 m^3/s, determine: [8]

i) Flow depth downstream of the jump
ii) Trust on the gate; and
iii) Energy losses in the jump

Assume the losses through the gate is 5% of velocity head of flow gate.

b) Derive the expression for most economical rectangular section. [3]

c) A trapezoidal channel has side slope 1:2 (H:V) and the slope of the bed is 1 in 1500. The area of the section is 40 m^2. Find the dimensions if it is most economical. Determine the discharge of the most economical section if Chezy's constant (C) = 50. [5]

5. a) Sketch the water-surface profile in along rectangular channel (n=0.014), f the channel is 3 m wide; the flow rate is 9.6 m^3/s; and there is an abrupt change in slope from 0.0016 to 0.0150. [8]

b) What do you mean by incipient motion condition? Derive an expression for the shear stress reduction factor or tractive force ratio in the case of mobile boundary channel in terms of side slope angle and angle of repose of the sediment. [2+6]

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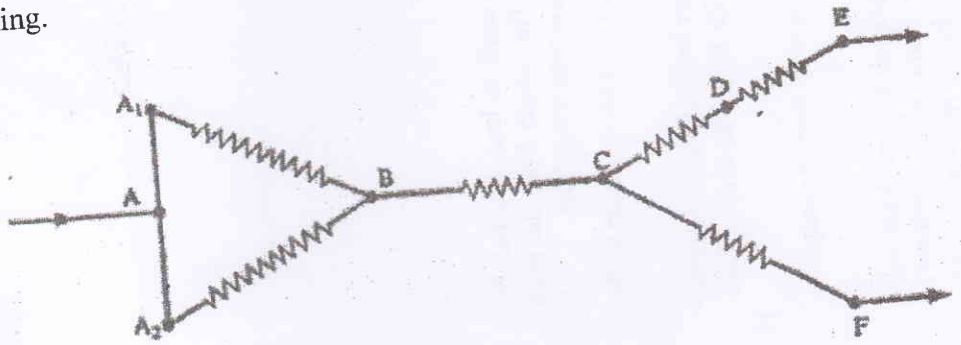
01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Baisakh

Exam.	**Back**		
Level	BE	**Full Marks**	80
Programme	BCE, B.Agri.	**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**.*
- ✓ *Assume suitable data if necessary.*

1. A system of pipes conveying water is connected in parallel and in series as shown in figure below. The section DE represents the resistance of a valve for controlling the flow, which has a resistance coefficient $K_{DE} = \left(\frac{4000}{n}\right)^2$, where n is the percentage valve opening.



The friction factor f in the Darcy formula is 0.024 for all pipes, and their lengths and diameters are given by

Pipe	Length (m)	Diameter (m)
AA_1B	30	0.1
AA_2B	30	0.125
BC	60	0.15
CD	15	0.1
CF	30	0.1

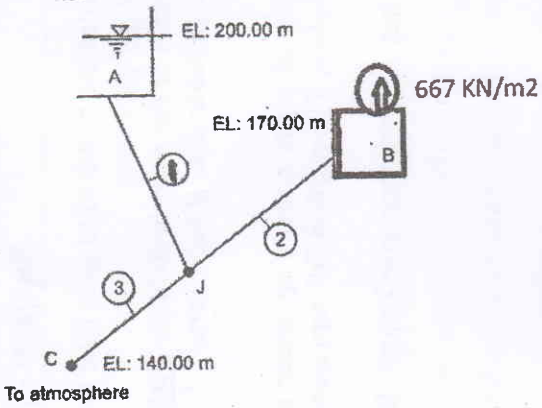
The head at A is 100m, at E is 40 m and at F is 60m. If the valve is adjusted to give equal discharge rates at E and F, calculate the head at C, the discharge through the system and percentage valve opening. Neglect all losses except those due to friction. [10]

2. A cast iron pipe of 300 mm diameter and 8 mm thick is 1500 m long. The pipe is to convey 200 litres per sec of water.
   a) Estimate the maximum time of closure of a valve at the downstream end that would be recognized as rapid closure?
   b) What is the peak water hammer pressure produced by rapid closure?
   c) What is the length of the pipe subjected to peak water hammer pressure if the time of closure is 2.0 sec? (For water E = 2200 MPa; for cast iron $E = 80 \times 10^9 Pa$) [2.5+2.5+3]

P.T.O.

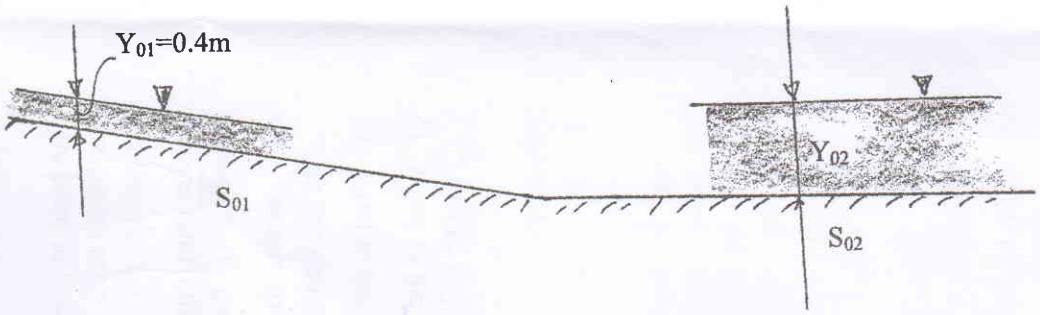
3. For the reservoir system shown in figure, determine the flow in each pipe. At C, the pipe discharges into the atmosphere at a elevation of 140.00 m and at Tank B, the top is closed with pressure of 667 KN/m^2 of Hg. Take f =0.02 for all pipes and use following data: [8]

Pipe	Diameter	Length
1	15 cm	800 m
2	20 cm	500 m
3	30 cm	600 m



4. Pipes of 75 mm are to be used to syphon water from a main canal to branch canal, the difference of water level between the two canals being 15m. The length from the main canal to the summit of the pipe line is 20m. The total length of the pipe being 50m.
   a) Determine the number of pipes required to discharge at least 50 l/sec of water to the branch canal.
   b) Find also the maximum height of the summit above the water level of the main canal in order the pressure at the summit may not fall below 25 KPa (absolute). Take f = 0.03 and ignore minor loss. [4+4]
5. Explain variation of hydraulic radius with respect to depth in a very deep rectangular channel with suitable illustration. [6]
6. A 3m wide rectangular channel carries a discharge of 15m^3/s at a depth of 2 m. What will be the minimum height of hump at which the depth over the hump will be critical? Calculate the height of hump for which upstream water depth will be 2.5 m. What will be the depth of flow on the upstream and on the hump when its height is 0.2 m? [8]
7. A 3.6 m wide rectangular channel had badly damaged surfaces and had a Manning's n = 0.030. As a first phase of repair, its bed was lined with concrete with n = 0.015. If the depth of flow remains the same at 1.2 m before and after the repair, what is the increase of discharge obtained as result of repair. [7]
8. A rectangular channel section has a change in slope as shown in figure below. The channel is 4m wide having Manning's n = 0.0165. The bed slope S_{o_2} = 0.0024 and the flowing discharge is 16 m^3/sec.
   a) Calculate the depth that must exist in the downstream channel for a hydraulic jump to terminate at uniform flow condition.

b) If upstream depth Y_{01} = 0.4m, calculate the length of hydraulic jump using at least three increments of depth in a step calculation. [5+5]



9. Draw a hydraulic jump profile and indicate conjugate depths and energy loss using specific energy and specific force diagram. Hence derive momentum equation for the hydraulic jump in rectangular channel. [8]

10. Distinguish between Rigid boundary and Mobile boundary channels with respect to design principle. Explain the procedures of designing rigid boundary channel by minimum permissible velocity approach. [3+4]

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Bhadra

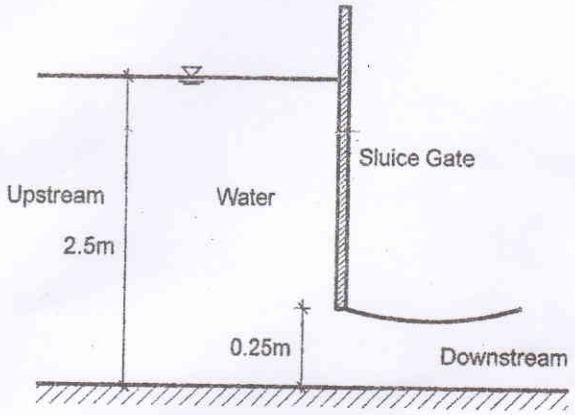
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, B. Agri.	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

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

1. In a hydro dynamically rough pipe of 100 mm diameter, the ratio of velocities at 10 mm and 30 mm from the pipe wall is 0.838. Determine the average height of the wall roughness, shear stress at the wall and mean velocity of flow if velocity at 30 mm is 1.90 m/s. [8]
2. A single uniform pipe joins two reservoirs. Calculate the percentage increase of flow rate obtainable if, from the mid-point of this pipe, another of the same diameter is added in parallel to it. Assume equal friction factor for both pipes and neglect minor losses. [8]
3. A reservoir A feeds two lower reservoirs B and C through a single pipe 10 km long, 750 mm diameter having a downward slope of 2.2×10^{-3}. This pipe then divides into two branch pipes, one 5.5 km long laid with a downward slope of 2.75×10^{-3} (going to B), the other 3 km long having a downward slope of 3.2×10^{-3} (going to C). Calculate the necessary diameters of the branch pipes so that the steady flow rate in each shall be 0.24 m^3/s, when the level in each reservoir is 3 m above the end of the corresponding pipe. Neglect all losses except pipe friction and take f = 0.025 throughout. [10]
4. Discuss Water hammet phenomenon. Develop Euler's equation as well as continuity equation for unsteady flow. [8]
5. Define steady Non uniform and spatially varied flow. Give at least two examples of each flows. [3]
6. a) Design an economical trapezoidal channel with a velocity of 0.6 m/s. The side slope Z of cannel is 1.5 and conveys a discharge of 3 m^3/s. Take manning's coefficient as 0.003. Also find the required bed slope. [6]
   b) Define hydraulic exponent. Show that the value of hydraulic exponent for rectangular section is equal to 10/3. [4]
7. a) Water flows in a 4 m wide rectangular channel at a depth of 1.8 m and velocity 1.4m/s. The channel is contracted to a width of 1.25m in particular reach. Is the flow possible in given specific energy? If not, what should be the discharge in channel so that flow is possible in the given specific energy? Also determine the depth of flow at contracted section and upstream of contracted section. [2+2+3]

b) Figure shows flow through the sluice gate provided in a rectangular channel of width 10 m. If the discharge in the channel is $7m^3/s$, determine the force exerted by water in the gate. Take momentum correction factor equals to 1.15. [5]

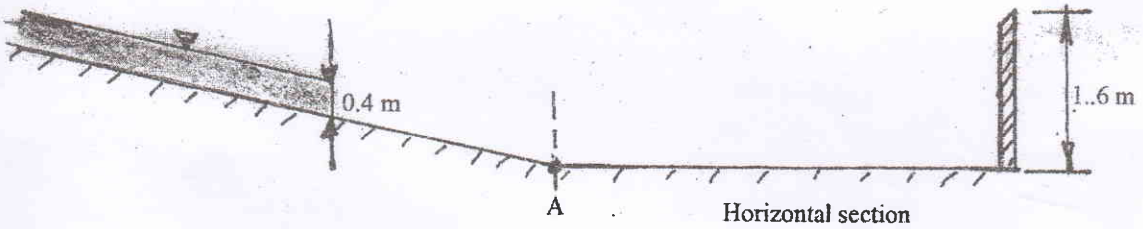


8. What is a mild slope? Justify analytically the nature of surface profiles (both upstream and downstream end) for mild slope. [1+4]

9. The partial water surface profile shown in figure below is for a rectangular channel of 3 m width in which water is flowing at a discharge of $5m^3/sec$.

   a) Does a hydraulic jump occur in a channel? If so, is it located upstream on downstream at point A? [5]

   b) Draw and name water surface profile. [5]



10. Why shear stress reduction factor "K" is necessary while designing the mobile boundary channel? Explain the design procedures (step by step) of mobile boundary channel by maximum permissible velocity approach. [2+4]

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155

01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Ashwin

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

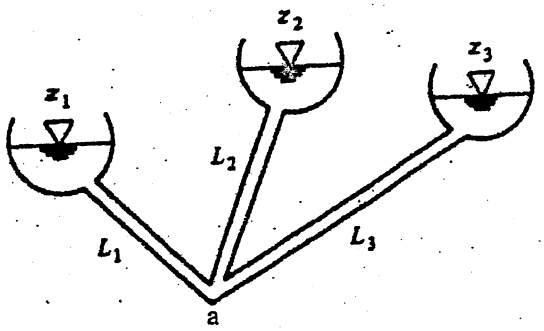
Subject: - Hydraulics *(CE555)*

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

1. A horizontal pipe 60mm in diameter carries oil of specific gravity 0.8. The pressure difference between two sections 5km apart is found to be 200 kPa. The oil flowing through the pipe is collected in a tank. It is found that 1962 N of oil is collected in 4 minutes. Compute the dynamic viscosity of the oil. Assume the flow to be laminar and verify it. Also, find the velocity at a distance of 20 mm from the pipe wall. [4+2+2]

2. Two reservoirs are connected by a pipe 1000 m long of diameter 300 mm. The pipe passes over a hill whose height is 5 m above the level of water in the upper reservoir. The difference in water levels in the two reservoirs is 13 m. If the absolute pressure of water anywhere in the pipe is not allowed to fall below 1.2 m of water in order to prevent cavitations, calculate the length of pipe in the portion between the upper reservoir and the hill summit; and also the discharge through the pipe. Assume the reservoirs are open to the atmosphere having atmospheric pressure of 760 mm of mercury. Take friction factor, f = 0.032 and neglect bend losses. [8]

3. For the three reservoir system of figure below Z_1 = 29 m, L_1 = 80 m, Z_2 = 129 m, L_2 = 150 m, Z_3 = 69 m and L_3 = 110 m. All pipes are 250 mm diameter concrete with roughness height 0.5 mm. Compute the flow rates. Take $\upsilon = 1.02\times16^{-6} m^2/s$. You are not allowed to use the Moody's chart. [10]



4. Explain the water hammer phenomenon and mention its causes. Derive the momentum equation for unsteady flow through pipe. [3+5]

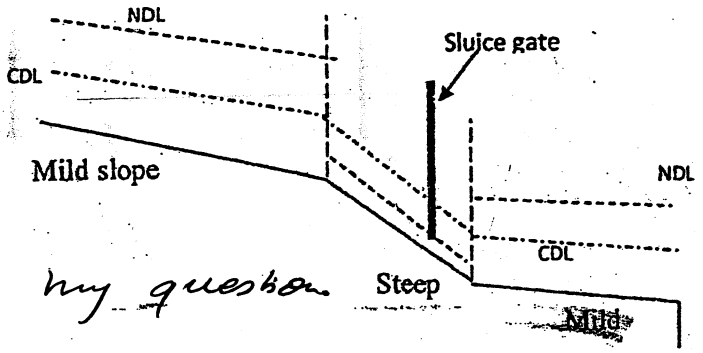
5. Define the following; non-perismatic channel, spatially varied flow, hydraulic slope, gradually varied flow. [4]

6. a) Determine the most economical section of a trapezoidal channel with side slope of 2:1, carrying a discharge of $9 m^3/s$ with a velocity of 0.75 m/s. Take Manning's n = 0.025. For conveying the same discharge, if a rectangular channel 1.2 m deep and 3 m wide is provided, what would be the saving in power per km length of channel? [4+2]

b) Using Manning's equation, show that the depth of flow is equal to 94% of the diameter for the partially filled most economical circular channel considering maximum discharge. [4]

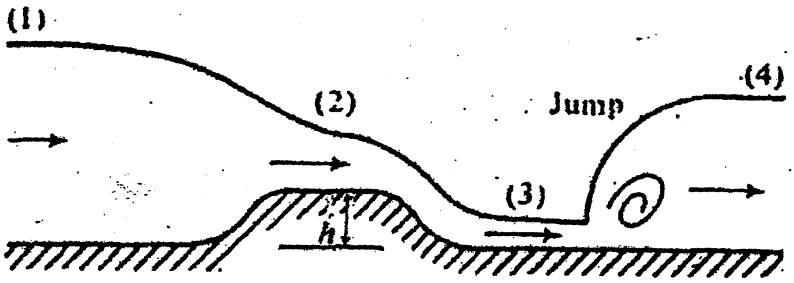
7. A trapezoidal channel of base width 6 m and side slope of 2 horizontal to 1 vertical carries a flow of 60 cumecs at a depth of 2.5 m. There is a smooth transition to a rectangular section 6 m wide accompanied by a gradual lowering of the channel bed by 0.6 m (i) Find the depth of water in the rectangular section and the change in water surface level. (ii) In case the drop in water surface level is to be restricted to 0.3 m. What is the amount by which the bed must be lowered? Assume no losses. [6+6]

8. a) Sketch the flow profile. [3]



b) Justify analytically the nature of surface profiles in critical sloped channels. [5]

9. Water in a horizontal channel accelerates smoothly over a bump and then undergoes a hydraulic jump as in figure below, if $y_1 = 1$ m, $y_3 = 30$ cm, estimate v_1, v_3, y_4 and bump height h. Neglect friction. [6]



10. a) Explain the Tractive Force Method of designing Mobile boundary channel. [3]

b) Design a regime channel for a discharge of 75 m^3/s and soil particle size of 0.65 mm using Lacey's method. Assume suitable side slope of channel. [3]

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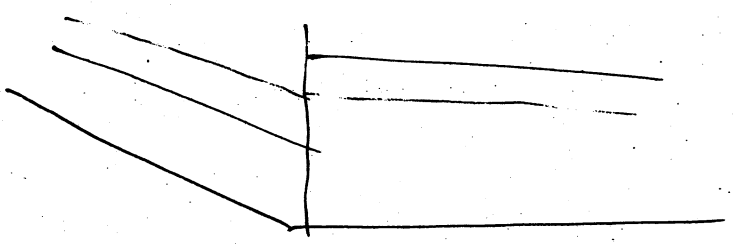

3

06 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Magh

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE, B. Agri.	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.*
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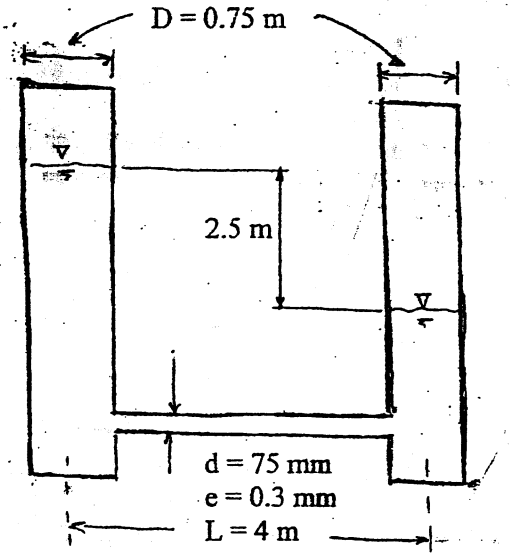
- ✓ ***Necessary figures are attached herewith.***
- ✓ *Assume suitable data if necessary.*

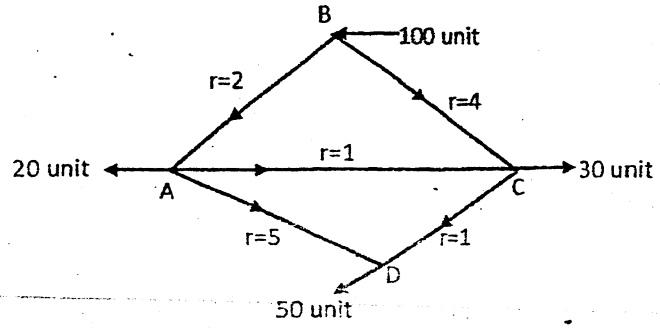
1. Water flows by gravity in two open stand pipes shown in figure. Estimate the rate of change of water level in left standpipe. [8]



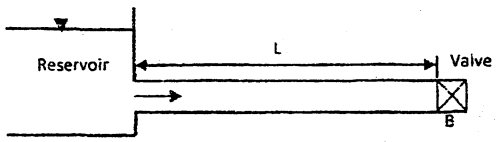
2. Water from a main canal is siphoned to a branch canal over an embankment by means of a wrought iron pipe of 100 mm diameter. The length of the pipeline up to the summit is 30 m and the total length is 90 m. Water surface elevation in the branch canal is 10 m below that of main canal. Take f = 0.025 and consider all losses. [4+4]
   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 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?

3. Verify whether the following suggested distribution of discharge in the pipelines of the network shown in figure below is satisfactory by using Hardy-cross method. If not, determine the proper distribution. If the elevation at point B is 50 m and pressure head is 40 m and the elevation at D is 40 m, find the pressure at D. [8+2]

Line	AB	BC	CD	DA	AC
Suggested discharge (units)	58	42	32	18	20



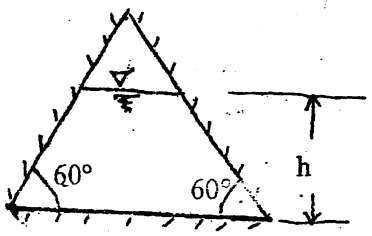
4. a) In the figure below, water flowing through a pipe from the reservoir is suddenly stopped by closing a valve at point B. Draw pressure-time diagram at the 2/3 L form valve of the pipe for one cycle of wave motion. [2]



b) Water flows through a 25 cm diameter 1500m long pipe at rate of 75 lps. The static pressure of water in the pipe is 200m at the downstream end of the pipe and the thickness of the pipe material is 6 mm. If a valve at the downstream end closed in 3 sec estimate the stress in the pipe wall. Take Bulk modulus of water = 2.2×10^9 N/m^2 and Young's modulus of elasticity of steel = 2.1×10^{11}N/m^2. [6]

5. Define the following; Hydraulic depth, Energy slope, gradually varied flow and spatially varied flow. [4]

6. a) In a partially full channel having a triangular section as shown in figure, the rate of discharge $Q = KAR^{2/3}$, in which K = a constant; A = flow area and R = hydraulic radius. Determine the depth at which the discharge is maximum. [5]

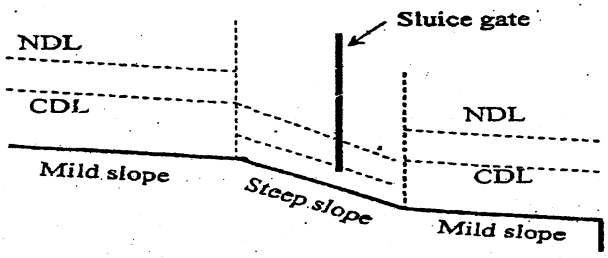


b) The velocity distribution in a channel section may be approximated by the equation $u = u_o(d/d_0)^n$ in which u is the flow velocity at depth d; u_0 is the flow velocity at depth d_0 and n = a constant. Derive expression for the energy and momentum coefficient. [5]

7. a) Define specific energy. Show that the flow is critical when the discharge is maximum for the given specific energy. Water flows at a depth of 1.8 m and velocity of 1.5 m/s in a 3 m wide rectangular channel. Find the width at contraction which just causes critical flow without a change in the upstream depth. [1+4+3]

b) An open rectangular channel carrying a discharge of 4.25 m^3/s is flowing at a depth of 1.15m with energy of 1.2 m and a width of 3 m. The flow encounters a simultaneous gradual contraction to a width of 1.5 m and a smooth downwards step of 0.6 m. With these flow conditions, determine the depth of the downstream flow. [4]

8. a) Sketch the flow profile: [4]



b) Justify analytically that A_3 curve meets the y_c line and channel bottom normally. [4]

9. What is hydraulic jump? Why is energy principle not applied for the analysis of the jump? Water flows in a 5 m wide rectangular channel at Froude number 3.5; the depth of flow is 1.2 m. If water undergoes a hydraulic jump, what is the Froude number downstream of jump? [1+1+4]

10. Explain the Tractive Force Method of designing Mobile boundary channel. Show the shear stress distribution on the Alluvial channel boundary with values. [3+3]

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 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 *(CE555)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
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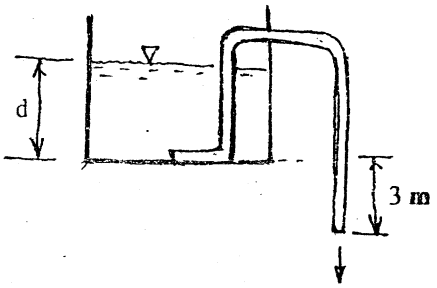
- ✓ ***Moody diagram provided.***
- ✓ *Assume suitable data if necessary.*

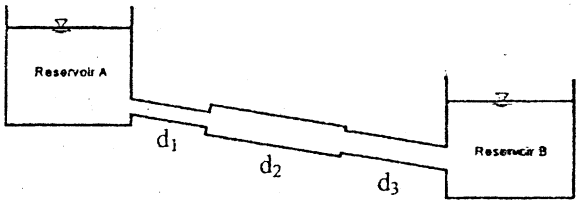
1. A total 12 liters per sec of oil is pumped through 2 pipes in parallel, one 12 cm in diameter and the other 10 cm in diameter, both pipes 1000 m long. The specific gravity of oil is 0.85, average roughness height is 0.26 mm for both pipes and kinematic viscosity is 9 cm^2/sec. Calculate the flow rate through each pipe, and power generated by pump. [8]

2. a) Small swimming pool is drained with velocity of 1.2 m/sec using a pipe with hose diameter 20 mm, length 30 m, and absolute roughness e = 0.2 mm. Find the water depth "d" at instant shown in figure below considering minor head loss coefficient at entrance K = 0.5. [5]



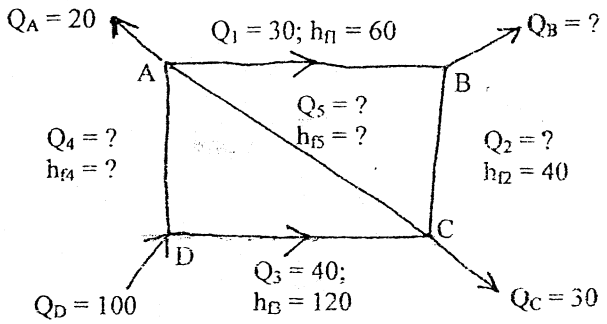
b) Draw HGL and EGL diagram for the flow system shown in the figure considering all major and minor losses. [1.5+1.5]

$d_1 < d_3 < d_2$



3. a) What do you understand by branching pipe system? Explain. Describe the solution procedures for three possible different cases of three reservoir problem. [6]

b) A pipe network is shown in figure in which Q and h represents the discharge and head losses respectively. Determine head losses and discharge indicated by a question mark, for this pipe network. [4]

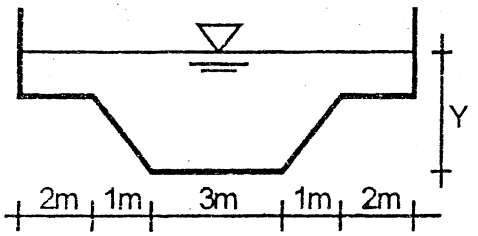


4. Water is flowing from a reservoir in a pipe of 600 mm diameter, 3000 m long and 6 mm thick at a velocity of 3.5 m/s. Assuming the value of bulk modulus of elasticity for water as 2.06 GPa, modulus of elasticity for pipe material 206 GPa and velocity of pressure wave 1400 m/s. Draw pressure-time diagram at location 1200 m from reservoir if the valve located at the end of the pipe is closed in 1 second. [8]

5. Define bed slope, hydraulic slope and energy slope. Why for non-uniform flow, these slopes are not parallel to each other, explain with neat sketch. [4]

6. a) Prove that for compound open channel, velocity distribution coefficient (momentum correction factor) $\beta = \dfrac{\sum\left(\dfrac{K_i^2}{A_i}\right)\left(\sum A_i\right)}{\left(\sum K_i\right)^2}$, where K_i = Conveyance factor of i^{th} section, A_i = Cross section area of i^{th} section. [4]

   b) For given channel section shown in the figure below with bed slope = 0.00017, Manning's roughness coefficient = 0.018, discharge 8.97 m^3/s, and side slope as 1:1, determine the normal depth of flow for uniform flow. [6]



7. A rectangular channel with a bottom width of 5 m, bottom slope of 0.00076 and energy correction factor of 1.1 has a discharge of 1.85 m^3/s. In a Gradually varied flow in this section the depth at certain location is found to be 0.25 m, considering Manning's roughness coefficient as 0.0165 determine the type of GVF profile. How far upstream or downstream will the depth be 0.40 m from depth 0.25 m. Use direct step method using increment equals to 0.05 m. [8]

8. a) A 3.5 m rectangular channel carries discharge of 4 m^3/s of water at a depth of 1.2 m. If the width is reduced to 2.0 m and bed raised by 0.15 m, determine the depth of flow at reduced section and upstream of the reduced section. [6]

   b) Find the expression for the specific force. Show that the flow is critical when the specific force is minimum. Explain the use of this concept in open channel flow. [4+2]

9. A rectangular channel with width 1.1 m carrying a flow discharge of 7.2 m^3/s changes its bed slope from 0.065 to 0.0085. Show that the hydraulic jump occurs and if so find the location of jump. Take Manning's roughness as 0.025. [6]

10. Define an alluvial channel and incipient motion. Find the expression for the shear reduction factor "K" and explain the physical meaning of this factor. [1+3+2]

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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]

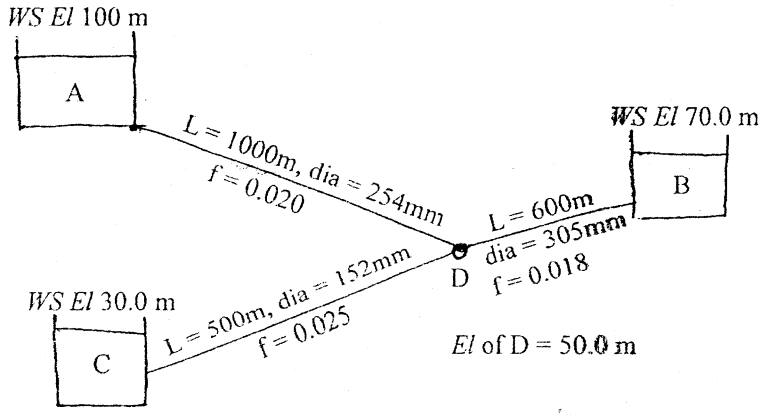
   a) If the total quantity of water required to be conveyed is 0.05 m^3/s, how many pipelines are needed?

   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.

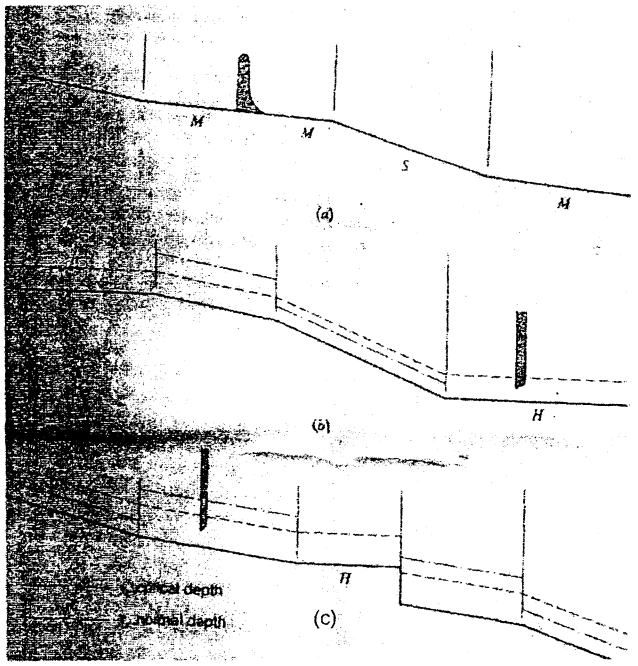
4. A steel pipeline (ϵ = 0.046 mm) 61 cm in diameter and 3.2 km long discharges freely at its lower end under a head of 61 m. What water-hammer pressure would develop if a valve at the outlet were closed in 4 sec? 60 sec? Wall thickness = 0.5 cm for both case of closure. Compute the stress that would 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: $\tau_c(N/m^2) = 0.155 + \frac{0.409 d_{mm}^2}{(1+0.177 d_{mm}^2)^{1/2}}$.

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, B.Agri.	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**.*
- ✓ *Assume suitable data if necessary.*

1. Show that for turbulent flow in rough pipes $\frac{V}{V^*} = 5.75\log\left(\frac{R}{K}\right) + 4.75$. [8]

   Where,

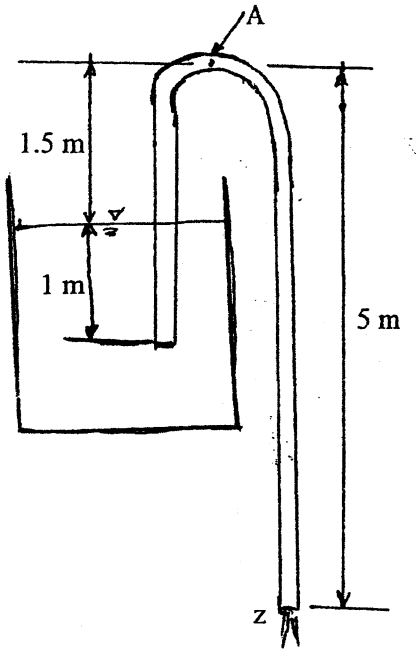
   V = Mean velocity

   V* = Shear velocity

   R = Radius of pipe

   K = Average height of surface protrusions

2. Liquid (s.g. = 0.6, $\nu = 5.0 \times 10^{-7}$ m^2/s) is drawn from a tank through a hose of inside diameter 25 mm (see figure). The relative roughness for the hose is 0.0004. Calculate the volumetric flow and the minimum pressure in the hose. The total length of hose is 9 m and the length of hose to point A is 3.25 m. Neglect minor losses at head entrance. [8]



3. Three reservoirs A, B and C are interconnected by three pipes which all meet at junctions J. The water surface of reservoir B is 20 m above the surface of C whilst the surface of A is 40 m above the surface of B. A flow control valve is fitted just before junction J in pipe AJ. [10]

   The head loss h_L through pipes and components can be written as $h_L = rQ^2$ where r is the resistance coefficient. The value of r for the valve and the pipes are $r_{AJ} = 150$, $r_{BJ} = 200$, $r_{CJ} = 300$, $r_{valve} = (400/n)^2$.

   Where n is the percentage valve opening. Find the value of n which will make the discharge into reservoir C twice into reservoir B.

4. a) Explain the importance of surge tank. Describe the types of surge tank. [1.5+1.5]

   b) A 300 mm diameter pipe of mild steel having 6 mm thickness carries water at the rate of 200 l/s. What will be the rise in pressure if the valve at the downstream end is closed instantaneously? Compare results assuming the pipe to be rigid as well as elastic. What should be the maximum closing time for the computed results to be valid? Take pipe length as 5.0 km, Modulus of elasticity of pipe material as 2.25×10^{11} N/m^2, Bulk modulus of elasticity of water as 2.0×10^9 N/m^2. [5]

5. Explain GVF, RVF and spatially varied flow with appropriate sketches. [4]

6. What condition make open channel flow uniform? The area of cross-section of flow in a channel is 6 m^2. Calculate the dimensions of the most efficient section if the channel is (a) triangular, (b) rectangular and (c) trapezoidal (2:1). Which has the least perimeter? [2+8]

7. a) A flow of 2 m^3/s is carried in a rectangular channel 1.8 wide at a depth of 1.0 m. Will critical depth occur at a section where (a) a frictionless hump 15 cm high is installed across the bed? (b) a frictionless sidewall reduces the channel width to 1.3 m? (c) the hump and the sidewall construction are installed together? [9]

   b) Define conjugate depths. Sketch the specific force curve showing conjugate depths and the zones of subcritical, critical and supercritical flow. [1+2]

8. A rectangular channel with a bottom width of 4 m, bottom slope of 0.00075 and energy correction factor of 1.1 has a discharge of 2.0 m^3/s. In a Gradually varied flow in this section the depth at certain location is found to be 0.2 m, considering Manning's roughness coefficient as 0.016 determine the type of GVF profile. How far upstream or downstream will the depth be 0.40 m from depth 0.20 m. Use Graphical Integration Method using increment equals to 0.1 m. [8]

9. For a hydraulic jump in a horizontal triangular channel show that $3Fr_1^2 = \frac{r^2(r^3-1)}{r^2-1}$,

   where $Fr_1^2 = \frac{v_1^2}{gy_1}$ and $r = \frac{y_2}{y_1}$. [6]

10. Write down the design procedures of mobile boundary channel using maximum permissible velocity method, tractive force method and regime theory approaches with appropriate expressions. [6]

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Magh

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

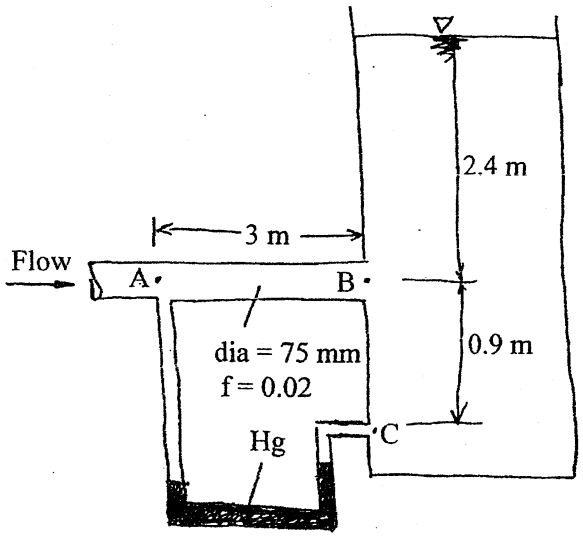
Subject: - Hydraulics *(CE555)*

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

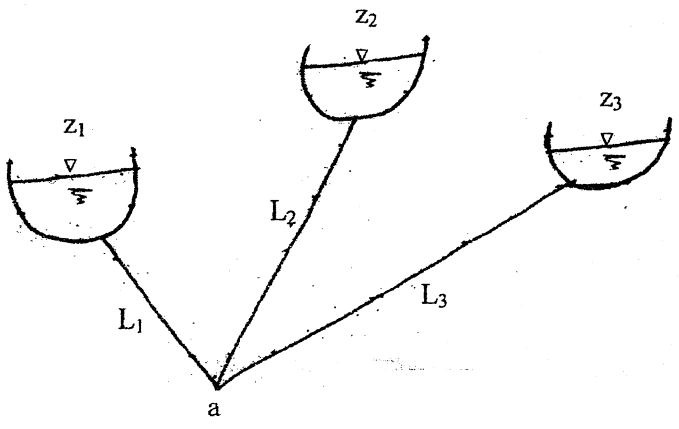
1. Show that in both smooth and rough pipes for turbulent flow $\frac{u-v}{v^*}=5.75\log\left(\frac{y}{R}\right)+3.75$

   Where v = mean velocity; u = point velocity at distance y from boundary. v* = shear velocity; R = Radius of pipe. [8]

2. Calculate the magnitude and direction of the manometer reading when water is flowing with velocity of 4.5 m/s for figure below. Consider minor losses also. [8]



3.



For the three reservoir system of above figure, z_1 = 29 m, L_1 = 80 m, z_2 = 129 m, L_2 = 150 m, z_3 = 69 m and L_3 = 110 m. All pipes are 250 mm diameter concrete with roughness height 0.5 mm. Compute the flow rates for water. [10]

4. a) Define water hammer and write down continuity equation and momentum equation for unsteady flow in pipe. [3]

   b) A value is closed in 4.5 s at the down stream end of a 3200 m pipeline carrying water at 2.7 m/s, What is the peak pressure developed by the closure, if the wave travels with velocity of 1000 m/s? Determine the length of pipe subject to the peak discharge. [5]

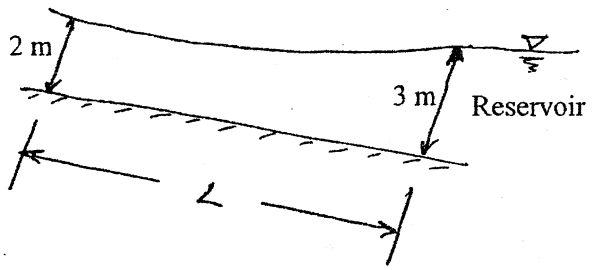
5. Given a practical example for each of the following open channel flow: (a) GVF (b) RVF (c) Spatially varied flow (d) Non uniform flow. [4]

6. a) Prove that for compound open channel, velocity distribution coefficient (Energy correction factor) $\alpha = \frac{\sum\left(\frac{K_i^3}{A_i^2}\right)\left(\sum A_i^2\right)}{\left(\sum K_i\right)^3}$, where k_i = Conveyance factor of i^{th} section, A_i = Cross section area of i^{th} section. [4]

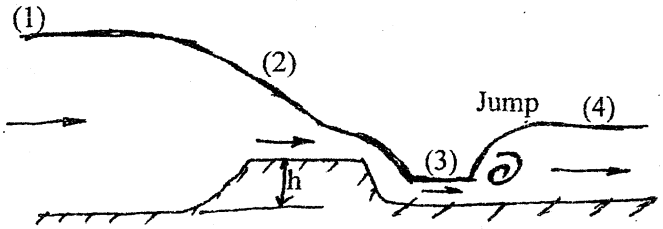
   b) Set up a general expression for wetted perimeter p_w of a trapezoidal channel in terms of the cross-sectional area A. depth y and angle of side slope ϕ. Then differentiate p_w with respect to y with A and ϕ held constant. From this, prove that R = y/2 for the section of greatest hydraulic efficiency (i.e, smallest p_w for a given A). [6]

7. What are the different conditions to be fulfilled when flow is critical open channel? A 3m wide rectangular channel carries 3 m^3/s of water at a depth of 1 m. If the width is to be reduced to 2 m and bed raised by 10 cm, what would be the depth of flow in the contracted section? What maximum rise in the bed level of the contracted section is possible without affecting the depth of flow upstream of transition? Neglect loss of energy in transition. What would be the change in water surface elevations if the rise in bed is 30 cm? [3+3+3+3]

8. The clean earth (n = 0.020) channel in figure below is 6m wide and laid on a slope of 0.005236. Water flows at $30m^3/s$ in the channel and enters a reservoir so that the channel depth is 3 m just before the entry. Assuming gradually varied flow, calculate the distance L. [8]



9. Water in a horizontal channel accelerates smoothly over a bump and then undergoes a hydraulic jump, as in figure below. If y_1 = 1 m and y_2 = 30 cm, estimate v_1, v_2 and y_4. Neglect friction. [6]



10. Describe the application of shield diagram for designing mobile boundary channel. [6]

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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]

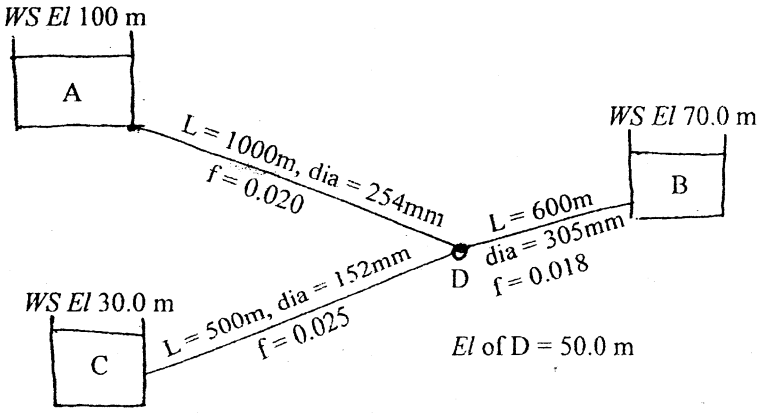
   a) If the total quantity of water required to be conveyed is 0.05 m^3/s, how many pipelines are needed?

   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]
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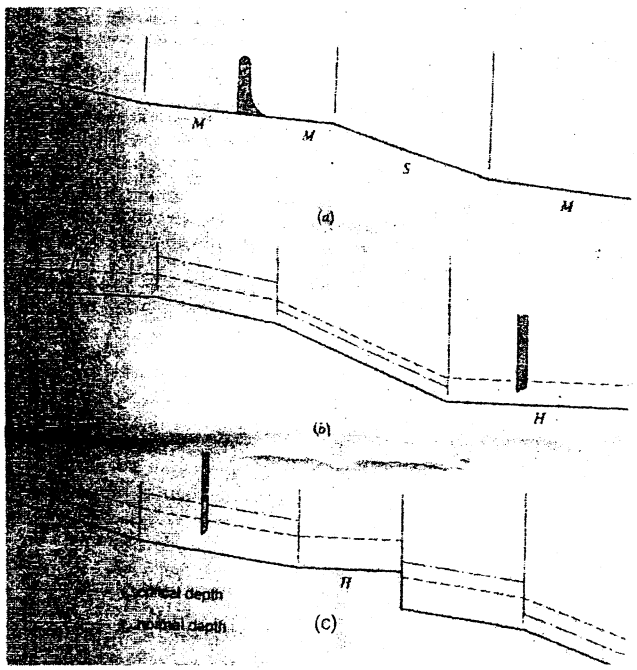
6. Explain specific energy diagram and show that at minimum specific energy, the flow is critical. A rectangular channel 2 m wide has a flow of 2.4 m^3/s at a depth of 1.0 m. Determine if critical depth occurs (a) at the section where a hump of ΔZ = 20 cm high is installed across the bed, (b) a side 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: $\tau_c(N/m^2) = 0.155 + \frac{0.409 d_{mm}^2}{(1+0.177 d_{mm}^2)^{1/2}}$.

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2069 Bhadra

Exam.	Regular (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**.*
- ✓ *Assume suitable data if necessary.*

1. Describe with appropriate expressions (a) Prandtl's mixing length theory (b) Hagen poisseuille equation (c) Nikuradse's experiments and (d) Colebrook-white equation. [8]

2. Two pipes have a length L each. One of them has diameter D_1 and the other has diameter D_2. If the pipes are arranged in parallel, the loss of head when a total quantity of water Q flows through them is H_1. If the pipes are arranged in series and the same quantity Q flows through them, the loss of head is H_2. If $D_2 = D_1/2$, find the ratio of H_1 to H_2, neglecting minor losses and assuming same f. [8]

3. A reservoir A discharges through a pipe 450mm in diameter and 900m long which is connected to two pipes, one 1200m long leading to reservoir B 36m below A and the other 1500m long leading to reservoir C 45m below A. Calculate the diameters of these two pipes if they have equal discharges which together equal that of a 450mm diameter pipe of length 2100m connected directly from reservoir A to reservoir B. Neglect all losses except those due to friction and assume that the friction factor f is the same for all pipes. [10]

4. Derive an expression for the pressure rise due to instantaneous closure of valve considering the pipe to be elastic. From the derived expression for elastic pipe, obtain the pressure rise for rigid pipe. [7+1]

5. Explain Gradually varied and spatially varied flow with one practical example for each. [4]

6. a) Develop the relationship between Chézy's coefficient, Manning's coefficient and Darcy's coefficient. [4]

   b) A rectangular channel 8m wide and 1.5m deep has a slope of 0.001 and in lined with smooth plaster. It is desired to enhance the discharge to a maximum by changing the dimension of the channel, but keeping the same amount of lining. Work out the new dimension and the percentage increase in discharge. Take roughness coefficient n = 0.015. [6]

7. What is specific force? Prove that for a given specific force the discharge in a given channel section is maximum when the flow is in the critical state. A venturiflume in a rectangular channel of width of "B" has the throat width of 'b'. The depth of liquid at entry is H and at the throat is h. Prove that following relation exists for the discharge and width ratio: [2+4+3+3]

$$Q = 3.13 b H^{3/2} \left(\frac{h}{H}\right)^{3/2}$$

$$\frac{b}{B} = \sqrt{3}\left(\frac{h}{H}\right) - \sqrt{3}\left(\frac{h}{H}\right)^{3/2}$$

8. Derive the dynamic equation of Gradually varied flow (GVF) and convert the derived equation for the case of wide rectangular channel, using Manning's equation, into following form: [8]

$$\frac{dy}{dx} = \frac{S_0\left[1-(y_n/y)^{10/3}\right]}{1-(y_c/y)^3}$$ Where S_0 = bed slope, y_n = normal depth, y_c = critical depth.

9. Draw a hydraulic jump profile and indicate depths and energy loss using specific energy and specific force diagram. Also derive momentum equation for the hydraulic jump in rectangular channel. [6]

10. A trapezoidal channel 1.5m deep, 10m bed width, with 2:1 side slopes is excavated in gravel of median size of 60mm. What is the maximum permissible channel slope and what discharge can the channel carry without disturbing its stability? Take angle of repose(ϕ) = 37° and K_2 = 0.9. [6]

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06 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2068 Jestha

Exam.		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 any Five questions.*
- *The figures in the margin indicate Full Marks.*
- *Assume suitable data if necessary.*

1. a) Obtain an expression for pressure rise due to closure of valve at the end of the pipe line when the valve is instantaneously closed. [8]

   b) A flow of $30 m^3/s$ is carried in a 5m wide rectangular channel at a depth of 1.0m. Find the slope necessary to sustain uniform flow at this depth if n = 0.012. What change in roughness would produce uniform critical flow at this discharge on this given slope? [8]

2. a) Derive an expression for the momentum equation in the case of hydraulic jump in the rectangular channel. Hence derive the relation between initial and sequent depths. [8]

   b) A rectangular concrete channel 4m wide has a slope of 9×10^{-4}. It carries a flow of $18 m^3/s$ and has a depth of 2.3m at one section. By using the direct step method and taking one step, compute the depth 300m downstream. Take n = 0.012. What is the type of surface curve obtained? [8]

3. a) Differentiate between mobile boundary and rigid boundary channel. Hence define critical tractive stress and incipient motion condition. [6]

   b) A reservoir A with surface level 60m above datum supplies to a junction box through a 300mmϕ pipe 600m long. From the junction box, 300mm and 200mm diameter pipes branch off. The 300 mm diameter pipe is 600m long and connected to a reservoir B of level 48.19m while 200mm diameter pipe is 300m long and is connected to a reservoir C of level 45.38m. Find the discharge into or from the reservoir B and C. Take f = 0.03. [10]

4. a) Derive the discharge equation for the trapezoidal weir. Discuss also the impact of approach velocity and end contraction while deriving such equation. [8]

   b) A smooth pipe carries $0.30 m^3/s$ of water discharge with a head loss of 3m per 100m length of the pipe. Determine the diameter of the pipe. Use friction factor equation for smooth pipe as $f = 0.0032 + \frac{0.221}{Re^{0.237}}$ and assume $\frac{\mu}{\rho} = 10^{-6} m^2/s$. [8]

5. a) Prove that the condition for most economical partially filled circular channel section for maximum velocity is h = 0.81D, Where h = depth for maximum velocity and D is diameter of the channel. [8]

   b) Pipes of 50mm diameter are to be used to siphon water from a main canal to a branch canal, the differences of water level between the two canals being 12m. The length from the main canal to the summit of the pipe line is 18m. The total length of the pipe being 45m. Determine the number of pipes required to discharge at least 60 liters/sec to the branch canal. Find also the maximum heigh of the summit above the water level of the main canal so that the pressure at the summit may not fall below 20KPa (absolute). Take f = 0.03. Ignore minor losses. [8]

6. a) Derive Darcy-Weisbach equation for the friction head loss in the pipe. What are Hydraulic grade and Total Energy lines? [8]

   b) For the purpose of discharge measurement, the width of a rectangular channel is reduced from 2.75 m to 2 m and the floor is raised by 0.3m at a given section. What rate of flow is indicated by a drop of 0.15 m in the water surface elevation at the contracted section when the depth of the approach flow is 2 m? [8]

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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

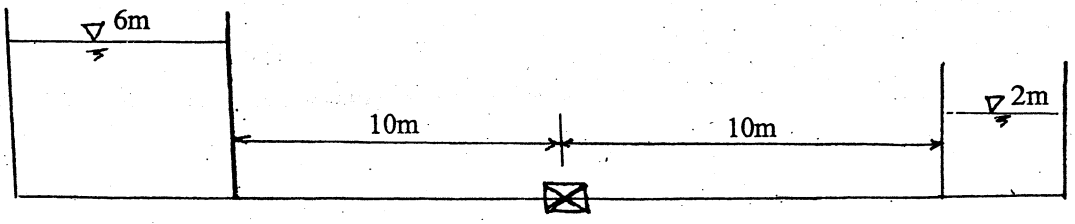
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Necessary figure is attached herewith.***
- ✓ *Assume suitable data if necessary.*

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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$E_1 = E_2 + \Delta Z$.

$E_1 = E_2$

06 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2067 Shrawan

Exam.	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 any Five questions.*
- ✓ *The figures in the margin indicate Full Marks.*
- ✓ *Assume suitable values of necessary.*

1. a) Describe the variation of pressure with time near the valve, with neat sketches, when flowing fluid in the long pipe is brought to rest by the valve at the downstream end of pipe. [8]

   b) Distinguish between most economical and most efficient channel section. Show that the most of economical trapezoidal channel section has its side slope equal to 60°. [8]

2. a) Starting from dynamic equation of GVF, prove that the flow profile slope for wide rectangular channel, using Manning's equation, will be:

$$\frac{dy}{dx} = S_0 \frac{1-\left(\frac{y_n}{y}\right)^{10/3}}{1-\left(\frac{y_c}{y}\right)^{3}}$$

   Where So = bed slope, y_n = normal depth, y_c = critical depth [4]

   b) Derive the equation for jump height calculation through the specific energy analysis. [6]

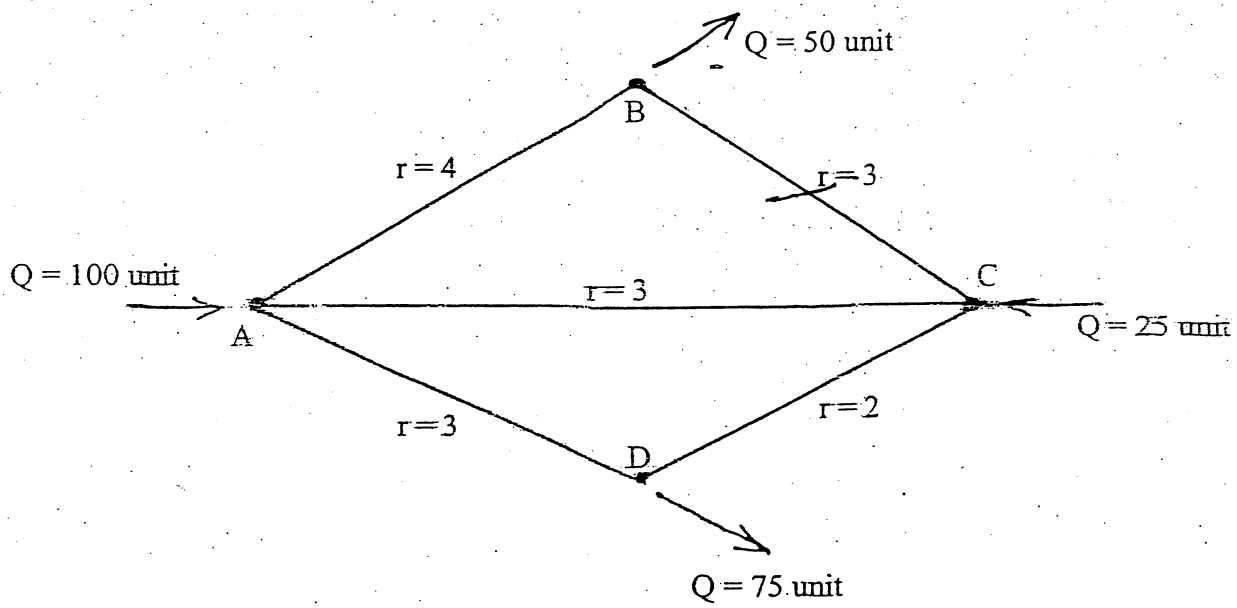
   c) There is a pressure loss of 300KN/m^2 when water is pumped through a pipeline A at a rate of 2 m^3/s and there is a pressure loss of 250 KN/m^2 when water is pumped at a rate of 1.4 m^3/s through pipeline B. Calculate pressure loss which will occur when 1.5 m^3/s of water are pumped through pipes A and B jointly if they are connected (i) in series, (ii) in parallel, assuming that junction losses may be neglected. In the latter case calculate the discharge through each pipe. [6]

3. a) Why the critical depth varies for the constriction flow analysis and does not vary for the hump flow analysis? Describe the specific discharge curve for the study of constriction flow analysis. [8]

   b) A pipe line 30m long connects two tanks which have a difference of water level of 12m. The first 10m of pipeline from the upper tank is of 40 mm diameter and the next 20m is of 60mm diameter. At the change in section a valve is fitted. Calculate the rate of flow when the valve is fully open assuming that its resistance is negligible and that f for both pipes is 0.0216. In order to restrict the flow, the valve is then partially closed. If K for the valve is now 5.6, find the percentage reduction in flow. [8]

4. a) Why it is necessary to include kinetic energy correction factor (α) in Bernoulli's equation and momentum correction factor (β) in momentum equation for the fluid flow analysis? Derive the expressions for kinetic energy correction factor and momentum correction factor. [8]

b) Using Hadry-Cross method find the discharge for each pipe as shown in figure below. [8



5. a) Define mobile boundary channel. Explain the use of shield diagram for designing mobile boundary channel. [6

b) A wide rectangular channel having a bottom slope of 5×10^{-3} has a constant value of Chezy's coefficient equal to 76. If discharge per unit width is $4.5m^2/s$ and channel ends as an abrupt drop, find the length of surface curve. Use direct step method taking maximum of 5 steps. [10]

6. a) What is Moody's chart? Describe the different flow zones in Moody's chart with necessary governing equations. [2+4]

b) Distinguish between major and minor head losses. Find the expression for minor head losses. [6]

c) The behavior of a river with discharge of 2000 m^3/s is required to be studied by making distorted model having horizontal scale ratio 1/1000 and vertical scale ratio 1/100. Find the discharge of the model [4]

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