TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2077 Chaitra

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

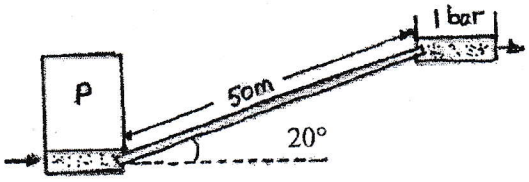
Subject: - Hydraulics *(CE 555)*

- ✓ 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) For the figure below, calculate:

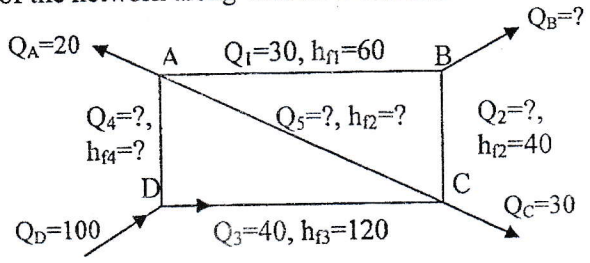
   What is the pressure needed to drive a viscous fluid upslope through a 12cm diameter pipe? The length of the pipe is 50m, slope is 20 deg. At the end of the pipe, the pressure is 1 bar. Oil of specific gravity 0.85 and viscosity 0.01 kg/m-s, and the target flow rate is 0.25 cubic meter per minute.

   (i) What is the pressure needed to drive the flow if there were no slope?
   (ii) The supplier is out of 12cm pipes and your manager wonders if multiple 8cm diameter pipes can be used side by side to achieve the same total flow rate at the same driving pressure, determine how many 8cm pipes are needed. Round up to nearest integer. [2+3+3]



   b) Describe Moody's Chart. What are the basis to draw such a diagram? State its uses. [2+4+2]

2. a) Figure below shows a network in which Q and h_r refer to discharges and pressure drops respectively. Subscripts 1, 2, 3, 4 and 5 designate respective values in pipe length AB, BC, CD, DA and AC. Subscripts A, B, C and D designate discharges entering or leaving the junction points A, B, C, and D respectively. By sticking to the values given in the figure find the following discharges Q_B, Q_2, Q_4 and Q_5 and the pressure drops h_{f4} and h_{f5} and give these computed values at their respective places on a neat sketches of the network along with flow directions. [4+4]



   b) A steel pipe 1.20m in diameter conveys 1.40m^3/s of water under a head of 300m. A value at the downstream end can be expected to close suddenly. Estimate the water hammer pressure due to this closure. Also determine the minimum thickness of the wall to the nearest millimetre needed to withstand the pressures involved. For steel: E=210kN/mm^2, and safe working stress = 0.1 kN/mm^2. For water: K=2.10kN/mm^2. [4+4]

3. a) Compare gradually varied flow, rapidly varied flow and spatially varied flow with sketches. [4]

   b) A 50m wide rectangular channel is carrying a flow of $250m^3/s$ at a flow depth of 5m. To produce critical flow in this channel, determine:

   (i) The height of the step in the channel bottom if the width remains constant.
   (ii) The reduction in the channel width if the channel-bottom level remains unchanged.
   (iii) A combination of the width reduction and the bottom step. [2+2+4]

   c) Develop the expression for specific force and explain the concept of conjugate depths using the specific force curve. [4]

4. a) Derive the equation of shear stress on the boundary of the open channel. Water flows in a channel whose bottom slope is 0.002 and whose cross section is as shown in figure below. The dimensions and the Manning' coefficients for the surfaces of different subsections are also given on the figure. Determine the flow rate through the channel and the effective Manning coefficient for the channel. [4+4]

   b) A hydraulic jump occurs in a 90° triangular channel. Derive an equation relating to two depth and the flow rate. If the depths before and after the jump in the above channel are 0.5m and 1.0m determine the flow rate and obtain Froude numbers before and after the jump. [6+2]

5. a) What is M1 Profile? A rectangular canal is 10m wide and carries a flow of $50m^3/s$. The bottom and sides of the canal are concrete-lined, the longitudinal bottom slope is 0.0006 and the canal ends in a free outfall. If the flow depth is critical at a distance of $4y_c$ upstream of the fall, what is the depth of flow 2km upstream of the fall? Use either direct integration method (Bresse's method) taking three steps or Standard step method. [2+8]

   b) Define mobile boundary and rigid boundary. 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. [1+2+3]

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