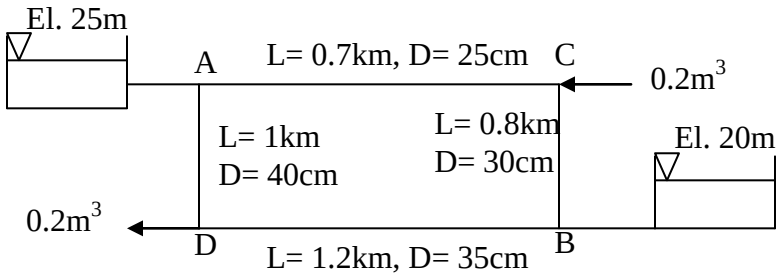
CIVL 4146 HYDRAULICS

Mid-Term Examination

Total marks: 100 Time allowed: 90 minutes

Attempt all the questions.

1. The water supply network shown in the figure below has constant-head elevated storage tanks at A and B, with inflows and withdrawals at C and D, respectively. The network is on flat terrain, and all the pipes are made of ductile iron (e=0.15mm). Calculate the flow in pipes AC, AD, BC and BD. Assume that the flows in all pipes are fully turbulent. Neglect the head loss in small length pipes by which the reservoirs are connected to the network. [30]



2.

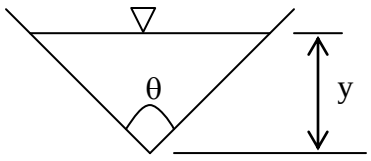
(a) Derive the relationship between Manning's roughness coefficient n and friction factor f. [10]

(b) Using the relationship derived in Part (a) and taking an example of cast iron pipe having 30 cm diameter, prove that Manning's n determined from f (using Moody's diagram) is approximately the same as standard value given. [10]

3. A pipe goes through a sudden contraction to half its diameter and then a sudden expansion back to its original size. Which loss is greater in this case, the expansion loss or the contraction loss? Prove your answer. [20]

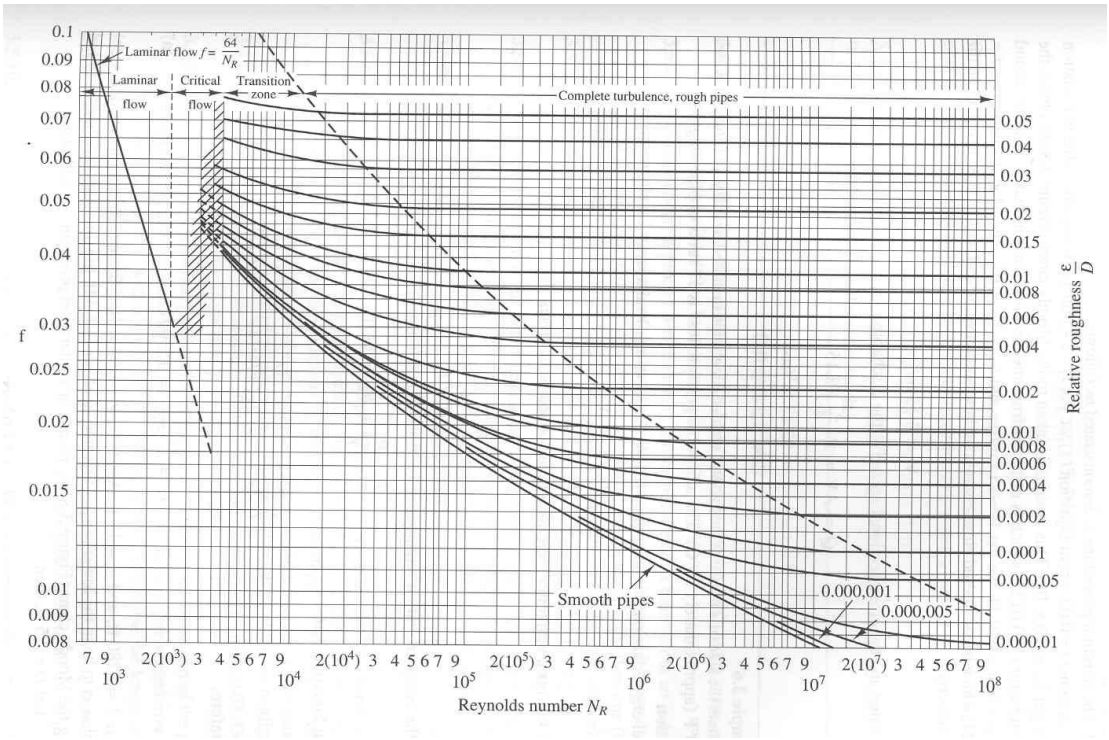
4.

(a) Derive the geometrical properties of the most efficient triangular open channel as shown below. [15]



(b) For a uniform depth of flow of 4.9 m in a triangular channel having n=0.02, longitudinal slope of 0.0003 and a discharge of 30m^3/s, compute the side slopes of the channel. [15]

The following information may be useful in solving the problems:



$$V = 0.85 C_H R^{0.63} S^{0.54} \qquad V = \frac{1}{n} R^{2/3} S^{1/2} \qquad h_E = \frac{(V_1 - V_2)^2}{2g}$$

$$\Delta = -\frac{\sum K Q_a^x}{\sum \left| x K Q_a^{x-1} \right|} \qquad h_f = f \frac{L}{D} \frac{V^2}{2g} \qquad u = \frac{P_1 - P_2}{4\mu L}\left(r_0^2 - r^2\right)$$

$$Q = \frac{\pi D^4 (P_1 - P_2)}{128 \mu L} \qquad \frac{1}{\sqrt{f}} = -2\ln\left(\frac{e/D}{3.7} + \frac{2.51}{N_R \sqrt{f}}\right) \qquad h_c = K_c \frac{V_2^2}{2g}$$

Material	e (mm)	n	C_H
Riveted steel	0.9-9.0	0.015	110
Concrete	0.3-3.0	0.015	110
Ductile and cast iron	0.26	0.013	120
Galvanized iron	0.15	0.012	120
Asphalt-dipped ductile/cast iron	0.12	0.012	140
Commercial steel or wrought iron	0.046	0.01	140
Copper or brass tubing	0.0015	0.01	130
Glass, plastic (PVC)	≈ 0	0.01	140

Table: Values of loss coefficient for sudden contraction

V_2 (m/s)	Ratio of smaller to larger pipe diameters, D_2/D_1									
	0.0	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**
1	0.49	0.49	0.48	0.45	0.42	0.38	0.28	0.18	0.07	0.03
2	0.48	0.48	0.47	0.44	0.41	0.37	0.28	0.18	0.09	0.04
3	0.47	0.46	0.45	0.43	0.40	0.36	0.28	0.18	0.1	0.04
6	0.44	0.43	0.42	0.40	0.37	0.33	0.27	0.19	0.11	0.05
12	0.38	0.36	0.35	0.33	0.31	0.29	0.25	0.20	0.13	0.06