Menoufia University
Faculty of Engineering
Shebin El-Kom
Department: Mechanical Engineering
2th Semester
Final Exam: 4 pages + sheet

Minufiya University

Post Graduate: Diploma
Subject: Pipe Network *(MPE520)*
Time allowed: 3hr
Full Mark: 100
Academic Year: 2017-2018
Date: 30/12/2017

Assume any missing data, state your assumption clearly, and Answer all questions

Question (1) (10+15=25 Marks)

1.a) Starting from first principles, show that the loss of head due to friction for water flows through a horizontal diffuser is given by,

$$h_f = \frac{f}{8\sin\theta}\left(1-\frac{1}{AR^2}\right)\frac{V_1^2}{2g}$$

Where, f =friction coefficient, AR=total area ratio, Θ=half-diffuser divergence angle, V_1=inlet velocity.

1.b) Consider the three-reservoir system of Fig. (1) with the following data: $L_1 = 95$ m, $L_2 = 125$ m, $L_3 = 160$ m, $z_1 = 25$ m, $z_2 = 115$ m and $z_3 = 85$ m. All pipes are 28-cm-diameter unfinished concrete ($\varepsilon = 1$ mm). Compute the steady flow rate in all pipes for water at 20°C ($\mu = 0.001$ Pa.s, ρ =998 kg/m^3).

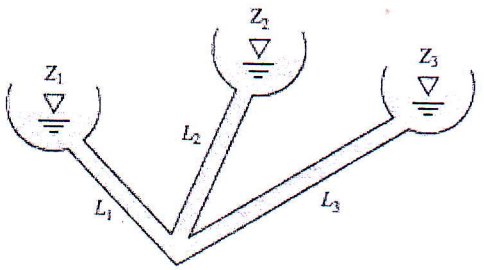

Fig.(1)

Question (2) (10+15=25 Marks)

2.a)A system of pipes conveying water is connected in parallel and in series, as shown in Fig. (2). the pipe friction factor is 0.024 for all pipes, and their lengths and diameters are given in the table:

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

If the whole of water-entering the branch CF is draw off at a uniform rate along the length of the pipe. Calculate the total difference of head between inlet and outlet when the inflow to the system is 0.28 m^3/s. Consider only frictional losses and assume atmospheric pressure at the end of branch. Also, calculate the head at C and the flow rates in the two branches.

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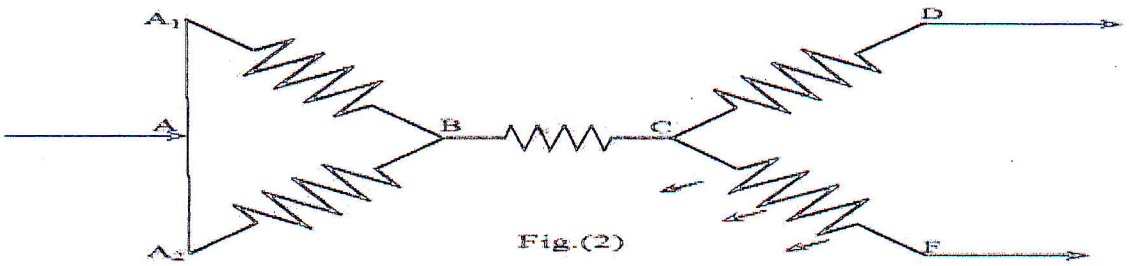
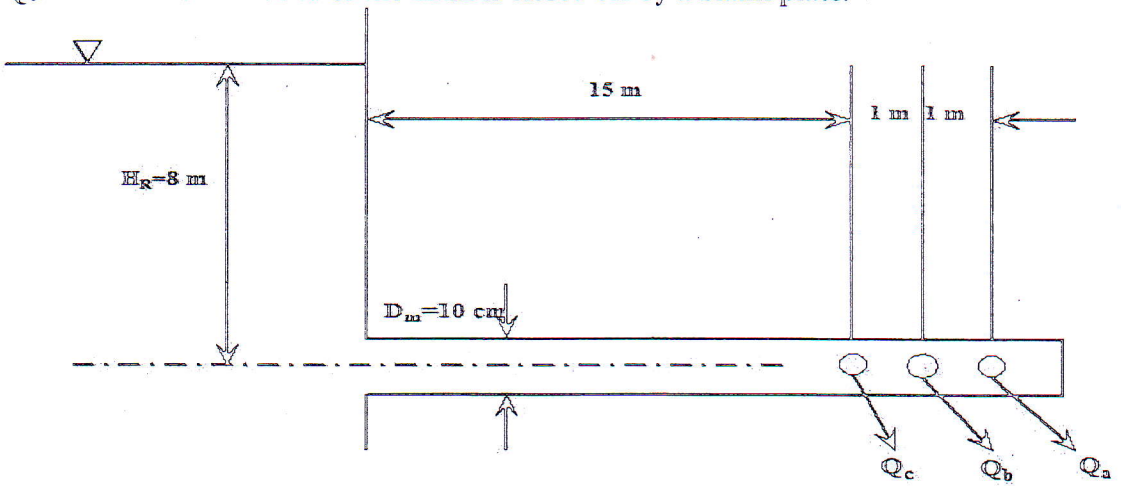


Fig.(2)

2.c) The 3-port manifold shown in the next diagram has a port-to-main diameter ratio $D_3/D_2=0.4$, a friction factor $f=0.02$ in the main and all laterals, and $L_3/D_3=4.0$ for each lateral. Considering fluid friction in the main and laterals and junction losses, compute the port discharges Q_a, Q_b and Q_c. The downstream end of the main is closed off by a blank plate.



Question (3) (25 Marks)

For the network shown in Fig. (3), write the following *Q*-equations; *H*-equations; and write the ΔQ-equations, then solve the system of ΔQ-equations.

pipe	1	2	3	4	5
D inch	8	6	6	8	6
L ft	1500	2000	1000	1700	2500
k	5.72	33.0	16.30	6.53	40.70
n	1.930	1.931	1.889	1.913	1.890

Question (4) (25 Marks)

The following network shown in the Fig.(4) contains a pressure reducing valve (PRV) that is set so it will produce a HGL of 145 m on its downstream side. This valve is 800 m downstream from node 1, answer the following equations: (a) write the system of Q-equations, H-equations and ; ΔQ-equations; (b) using the Newton method, solve the system of ΔQ-equations; (c) and what is the HGL on the upstream side of the PRV.

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Pipe	1	2	3	4	5
K	196	3520	2380	4130	192
n	1.819	1.955	1.895	1.892	1.834
D (mm)	400	250	250	250	300
L (mm)	1000	2500	2000	3500	500

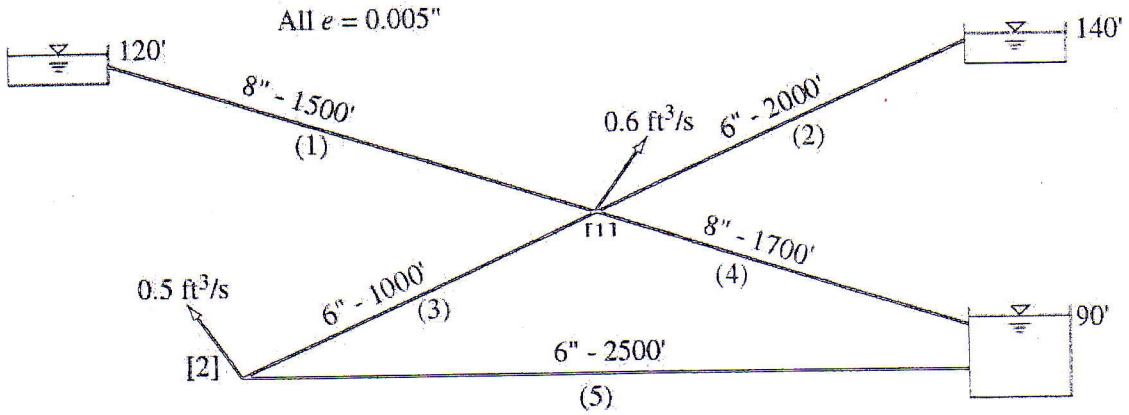

Fig. (3)

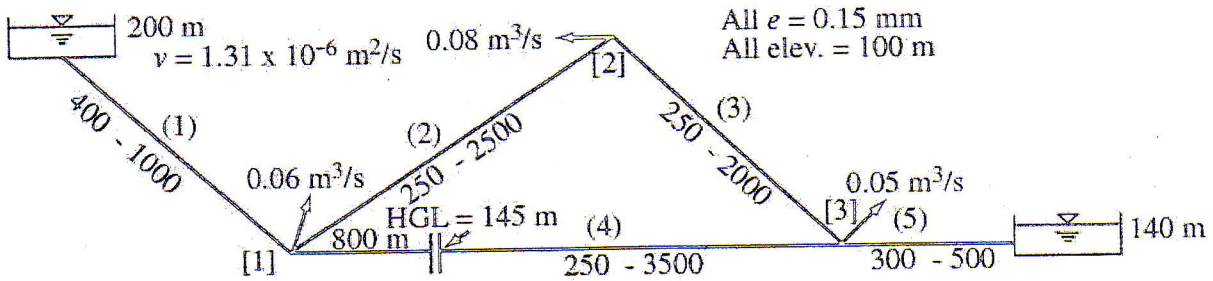

Fig. (4)

GOOD LUCK

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