Student Name……... **10/01/2009 – 13/01/1430 H**
Student ID No……… Second Mid Term Exam
King Saud University Time Allowed 1.5 hours
Civil Engineering Department **Attempt all 4 questions**

Hydraulics CE-322, First Semester (1429-1430)

……..

Question (1) **(5 Marks)**

A) A pump having N = 1500 rpm, Q = 3000 gpm, head = 80 ft, and power = 120 hp. Find its performance at N = 1800 rpm.

B) Two identical pumps are used in parallel to supply water between two tanks with a static lift of 40 ft. The pipeline is 8-in. in diameter and 2550 ft. in length. Each pump has the following characteristics:

Discharge (gpm)	Head (ft)	Efficiency (%)
0	132	
500	121	55
800	111	65
1000	105	68
1300	91	70
1600	71	67

If the friction coefficient f = 0.031, determine the following:

(i) operating condition
(ii) head and discharge developed by each pump
(iii) input power

Neglect minor losses

Question (2) **(4 Marks)**

A) A 6-in. pump operating at 1760 rpm delivers 1480 gpm for a head of 132 ft at its maximum efficiency. (a) Determine the specific speed. (b) If a similar unit of 8-in. diameter is used at 1760 rpm, determine its characteristics.

B) A centrifugal pump is to be placed above a large, open water tank and is to pump water at a rate of 0.5 cfs. At this flow rate the required net positive suction head is 15 ft, as specified by the pump manufacturer. Determine the maximum height Z, that pump can be located above the water surface without cavitation.

(P_{atm} = 14.7 psi and e_w = 0.507 psi)

Question (3) **(3 Marks)**

From a reservoir, water at a rate of 744 liter/sec flows through a horizontal cast-iron pipeline 1845 m long and 500 mm in diameter discharging into the atmosphere through a valve at the downstream end. The speed of the pressure wave is 1230 m/sec. The valve is fully closed in 6 sec. The area of the valve opening varies as shown in the table. Calculate the variation of pressure head at the valve during closure. Neglect the friction losses and take $C_d = 0.6$. Use the following relations:

$N = CV_o/2gh_0$

$\eta_i = A_i/A_o$ $\quad \zeta_i = (h_i/h_o)^{0.5}$ $\quad V_i = \eta_i \zeta_i V_o$ $\quad h_i = h_o \zeta_i^2$

$\zeta_i^2 + \zeta_{i-1}^2 - 2 = 2N (\eta_{i-1} \zeta_{i-1} - \eta_i \zeta_i)$

Time (s)	0	3.0	6.0
Valve Area (m^2)	0.06	0.030	0.0

Question (4) **(3 Marks)**

1- The pump is not suitable for a certain known piping system when:
- (i) The efficiency of the pump at the operating point is too low
- (ii) The available net positive suction head is greater than the required one.
- (iii) The power at the operating point is too high
- (iv) All the above

2- Cavitation occurs in pumps when;
- (i) The pressure in the suction inlet is negative
- (ii) The absolute pressure at the suction inlet falls below the vapor pressure
- (iii) The computed cavitation parameter is greater than the critical one
- (iv) The total pump head is less than the suction head

3- Two or more pumps are used in series when;
- (i) There is a cavitation problem
- (ii) The required capacity is too high for a single pump
- (iii) The specific speed of the pump is low
- (iv) The required head is too high for a single pump

4- A supercritical flow occurs when::
- (i) $F_r = 1.0$
- (ii) $F_r < 1.0$
- (iii) $F_r > 1.0$
- (iv) None of the above

5- If the depth of flow changes abruptly over a small length of channel, the flow is called:
- (i) Gradually varied flow
- (ii) Rapidly varied flow
- (iii) Uniform flow
- (iv) None of the above

6- For K=2.09 GPa, the wave speed for water flowing in a rigid pipeline is:
- (i) 1230 m/s
- (ii) 1600 m/s
- (iii) 1440 m/s
- (iv) None of the above