Kafrelshiekh University
Faculty of Engineering
Department of Mechanical Engineering
Year: 3 Subject: Hydraulic Machines
Final Exam: 2 pages
Name: Assoc. Prof. Ayman Bakry

Date: 10/01/2016

Time allowed: 3 hours

Full Mark: 90
Academic Number:

Please, answer the following questions (assume any missing data):-

1. **The dimensionless specific speed of a centrifugal pump is 0.06. Static head is 30 m. Flow rate is 50 l/s. The suction and delivery pipes are each of 15 cm diameter. The friction factor is 0.02. Total length is 55 m other losses equal 4 times the velocity head in the pipe. The vanes are forward curved at 120°. The width is one tenth of the diameter. There is a 6% reduction in flow area due to the blade thickness. The hydraulic efficiency is 80%. Determine the impeller diameter. Assume inlet flow is radial.**
   (10 Marks)

2. **A four stage centrifugal pump running at 600 rpm is to deliver 1 m^3/s of water against a manometric head of 80 m (assuming each stage contributes equal part to the head). The vanes are curved back at 40° to the tangent at outer periphery. The velocity of flow is 25% of the peripheral velocity at outlet. The hydraulic losses are 30% of the velocity head at the outlet of the impeller. Determine the diameter of the impeller and the hydraulic efficiency.** **(10 Marks)**

3. **The performance of a centrifugal pump that is running at 1000 rpm is given by:**

Q (lit/s)	0	40	80	120
H (m)	40	42	36	24
η %	0	0.6	0.76	0.58

This pump is used in a 15 cm pipe line 10 m long (f= 0.03) with three bends (C = 0.6). The coefficient of entrance loss is 0.8. Calculate the specific speed and the maximum discharge obtained and the shaft power required when the static lift is 15 m.
(15 Marks)

4- **In order to decrease the discharge, in problem 3, by 20% within the same system, two methods were proposed. One time is by using a valve and another time is by reducing the pump speed. What is the power lost in the valve in the first method, and what is the new running speed of the pump in the second method?**
(15 Marks)

5- **If two of such pump, in problem 3, are used. One is running at the nominal given speed of 1000 rpm and, however, the other is running at 900 rpm. Deduce the new performance table of the 900 rpm pump. Deduce the duty point with system in problem 3 and the consumed power at then.**
(15 Marks)

6- **Which method of connection (parallel or series) for the two pumps in problem 5 would you recommend to increase the discharge within the same system of problem 3? Then, calculate the required power to drive the pumps in both cases**
(15 Marks)

7- **Cavitation tests were performed on a pump giving the following results: the discharge of 0.05 m^3/s, the manometric head of 37 m, the barometric pressure 760 mm mercury, ambient temperature of 25 °C for which the vapor pressure is 24.26 mm mercury. Cavitation began when the total head at pump inlet was 4 m. Calculate the value of Thoma cavitation coefficient and the NPSH.**

If it is to operate at the same point on its characteristic in the ambient conditions of barometric pressure640 mm mercury and temperature of 10°C for which the vapor pressure is 8.82 mm mercury (the specific gravity of mercury is 13.6). What could be the maximum relative height of this pump above water level with respect to the previous ambient conditions? (10 Marks)

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د. أيمـن بكـــري