

الاداء حسن  
 مارك قوي  
 د/ ايمن بكرى



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

1- The following details refer to a water centrifugal pump. The impeller outer diameter is 30 cm in diameter and its inlet diameter is 15 cm. The impeller width at outlet is 2 cm. The blade angle at inlet is  $30^\circ$  and at outlet is  $25^\circ$ . The impeller speed is 1450 rpm. The impeller is designed for constant flow velocity through the impeller and for no-whirl at inlet. The input shaft power is 26.5 kW and the overall efficiency is 76%. Determine: the width of the impeller at inlet and the theoretical head developed by this impeller (15 Marks)

2- A centrifugal pump has the following characteristics at 1000 rpm:

Q (m <sup>3</sup> /h)	0	23	46	69	92	115
H (m)	17	16	13.5	10.5	6.6	2
Eff (%)	0	49.5	61	63.5	53	10

The pump is used to pump water from a low reservoir to a high reservoir through a total length of 800 m of pipe 15 cm in diameter. The difference between the water levels in the reservoirs is 8 m. considering only frictional losses where the friction factor is 0.016. Find the rate of flow between the reservoirs. Also determine the power input to the pump.

If the pump speed is reduced to 800 rpm, deduce all new performance data plus the input power performance and plot them in addition to the power curve. Also, determine the new operating point and the power. Identify the power consumed at zero discharge. (20 Marks)

3- (a) 0.05 m<sup>3</sup> /s of water flows from tank A to tank B due to a difference of water level of 6 m. In order to increase this discharge, a booster pump is used in the line. Calculate the percentage increase in discharge. The performance of the pump is given by  $H = 31.3 - 1.83 \times 10^3 Q^2$ .  
 (b) If a valve, located on the discharge side of the pump, is partially closed to reduce the discharge by 10%, how much power lost in the valve. (10 Marks)

4- The characteristics of two rotodynamic pumps at constant speed are as follows:

Pump A

Q (m <sup>3</sup> /s)	0	0.006	0.012	0.018	0.024	0.03	0.036
H (m)	22.6	21.9	20.3	17.7	14.2	9.7	3.9
Eff (%)	0	32	74	86	85	66	28

Pump B

Q (m <sup>3</sup> /s)	0	0.006	0.012	0.018	0.024	0.03	0.036
H (m)	16.2	13.6	11.9	11.6	10.7	9	6.4
Eff (%)	0	14	34	60	80	80	60

If they are used to lift water continuously through 3.2 m of vertical lift and the pipe to be used is 21 m long, 10 cm in diameter, and the friction factor is 0.02. Compare between the operation of the two pumps based on the delivered discharge, head, and input power. Which one would you prefer to use? (20 Marks)

- 5- If the pumps in problem (4) are used one time in series and another time in parallel, plot both characteristics curves for the two combinations. Determine the consumed power by the pumps in the two cases. (15 Marks)
- 6- Do the pumps in problem (4) operate free of or with cavitation? The suction pipe is 3 m long with the same pipe. The suction static lift is 0.5 m. If the water temperature is 25°C ( $p_v = 3.3$  kPa abs and water density = 997 kg/m<sup>3</sup>) and the atmospheric pressure is 101 kPa. Consider the Thoma cavitation factor as 0.25. (10 Marks)

---

انتهت الأسئلة،، مع أطيب الأمنيات بالتوفيق،،،

د. أيمن بكري