Kafrelshiekh University
Faculty of Engineering
Department of Mechanical Engineering
Year: 3 Subject: Hydraulic Machines
Final Exam: 1 page
Name: Prof. Ayman Bakry

Date: 15/01/2020

Time allowed: 3 hours

Full Mark: 90
Academic Number:

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

1- **A centrifugal pump running at 900 rpm delivers 800 lit/s against a head of 70 m. The outer diameter of the impeller is 0.7 m and the width at outlet is 7 cm. There is recirculation of 3% of volume delivered. There is a mechanical loss of 14 kW. If the hydraulic efficiency is 82% determine the blade angle at outlet, the motor power and the overall efficiency. The inlet whirl is assumed to be zero. (١٠ Marks)**

2- **An impeller with an eye radius of 100 mm and an outside diameter of 400 mm rotates at 1200 rpm. The inlet and outlet blade angles measured from the radial flow direction are 60^{o} and 70^{o} respectively, while the blade depth is 100 mm at inlet. Assume for a constant flow velocity, no shock at inlet and zero slip at outlet, the inlet whirl velocity is 0.3 m/s. Calculate: (a) volume flow rate through the impeller, (b) the absolute flow velocity at exit and its direction, (c) the theoretical and the actual heads if the hydraulic efficiency is 85%, and (d) the required power to drive the pump if the overall efficiency is 75% (e) the specific speed of this pump. (١٥ Marks)**

3- **The characteristics of a rotodynamic pump at constant speed of 1000 rpm is as follows:**

Q (m^3/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

If it is 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. Find the delivered discharge, head, and input power. (15 Marks)

4- **If it is required to reduce the discharge from the pump within the same system in question 3 using a throttle valve by 15%, determine the power lost in the valve. (١٠ Marks)**

5- **Deduce the performance curve of this pump when running at 900 rpm and plot the new performance curves on the same diagram of question 3. Also, find the new operating point and the input driving power when used in the same system of question 3. (15 Marks)**

6- **If two pumps in question (٣) 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)**

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)

أنتهت الأسئلة،، مع أطيب الأمنيات بالتوفيق،، د. أيمن بكري