Menoufiya University
Faculty of Engineering
Shebin El-Kom
Final Term Examination
Academic Year: 2010-2011

Minufiya University

Year: 3th year
Department: Mech. Power Eng.
Subject: Non Conventional Pumping Machines MPE 325A
Time Allowed: 3 Hours
Date: 4/6/2013 Total Mark (70)

Answer 5 Only From the Following Questions

1- a) Prove that the maximum ideal efficiency for the jet pump equal's 50%.
b) Describe the construction and working of the jet pump. What are the recommendations used for the jet pump design to obtain the maximum pump efficiency.
c) Draw the performance characteristics of the jet pumps.
d) A jet pump is fitted horizontally at 18.3m below the centrifugal pump level. The total delivery head from the centrifugal pump is 40 m. The loss of head in pipe between the jet pump outlet and the centrifugal pump inlet is 1.5 m and also 1.5 m for the pipe between the centrifugal pump outlet and the jet pump inlet. The suction head at the suction side of the jet pump is 6.1 m and the jet pump delivers 0.001262 m^3 / sec. If the flow ratio = 1.0. Give an expression for the jet pump efficiency and Find out: 1 – The pump output power. 2 – The pump input power. 3 – The jet diameter. 4 – The pump efficiency. (14Mark)

2-a) Explain with sketch the effect of rotor size on the theoretical, slip flow, net flow and volumetric efficiency for screw pumps.
b) Discuss how the screw pumps can be classified. How can the axial thrust for screw pumps be reduced .
c) Explain with sketch the effect of entrained and dissolved air on the liquid displacement and show how the amount of them can be reduced.
d) For the operating conditions 5% entrained gas, 9% dissolved gas at 0.986 bar abs., and a pump inlet pressure of 0.345 abs. Find the liquid displacement as % of theoretical displacement. (14Mark)

3- a) Define the cavitation phenomenon showing the reasons for causing cavitation in hydraulic machines and how can its effect be eliminated. What is the: $NPSH_{av}$ and $NPSH_{req}$.
b) Discuss how can the diaphragm pumps be classified, what are the practical applications and the advantages and disadvantages of the pump?
c) Explain the recommendations on installation and operation for improving rotary pump performance and life.
d) A radial piston pump has the following specifications : Piston diameter (16mm) – The pump has (7) pistons –Pump speed (1000) rpm - Eccentricity (8 mm) – Volumetric and overall efficiencies (98% and 70 %) - Pump Pressure (80 bar) . Find out: 1 – The pump actual flow rate .2 – The pump output power. 3 – Pump input power. (14Mark)

4-a) Draw a schematic of a rigid rotor vane pump with external liquid supply. Explain briefly its function and give an expression for its geometric volume.
b) How can the capacity of the rotary pumps be regulated, and how can the discharge pulsation be reduced.
c) Discuss the performance curves for rotary pumps showing the effect of increasing pressure on the pump performance and how this effect can preset.
d) A vane pump is to have a volumetric displacement of 98.4 cm^3. It delivers 0.00152 m^3/sec of oil at 1000 rpm and 90 bar. If the prime mover torque is 124.3 N.m. The pump has a rotor diameter of 63.5 mm, a cam ring diameter of 88.9 mm, and a vane width of 50.8 mm. Calculate: 1 - The eccentricity. 2 – The over all efficiency of the pump. 3 - The theoretical torque required to operate the pump. (14Mark)

5-a) What are the basic types of gear pumps . Explain with sketch theory of working of each type and its applications.

b) Draw and explain the working of the air – lift pump. What are the applications– advantages and disadvantages of the pump?

c) Draw and explain the pump head & ρ_{mix}.

d) An air – lift pump delivers 80 lit/min against a head of (90 m). The pump has the following specifications: Vsp =8.5, Hsub % =55 %, $\eta_m = 0.9$, $\eta_{iso} = 0.7$, $\eta_{mot} = 0.98$, $\eta_{dr} = 0.96$, $P_1 = 1$ bar. Calculate the following: 1– Volume of air consumed (lit/min). 2– Pressure at compressor outlet (bar). 3 – Pump output power. 4 – Power required for compressor. 5 – Pump efficiency.

(14Mark)

6- a) Draw a schematic of a swash plate axial piston pump. Explain briefly its function and give an expression for its geometric volume.

b) Explain the effect of pump pressure and viscosity on the mechanical and volumetric efficiency for rotary pumps.

c) A swash plate axial piston pump delivers 0.00033 m^3/sec at 3000 rpm, has the following parameters:

number of pistons $z = 7$ piston diameter $d = 10$ mm
pitch circle diameter $D = 35$ mm inlet pressure $Pi = 0.3$ MPa
exit pressure $P = 20$ Mpa volumetric efficiency = 0.94
total efficiency = 0.89 hydraulic efficiency = 1

(1) Calculate the swash plate angle, input mechanical power and driving torque. (2) Calculate the leakage flow rate.

(14Mark)

مع أطيب امنياتى بالتوفيق