Minoufiya University
Faculty of Engineering
Mechanical Power Eng. Dept.
Second Semester Examination
Academic Year: *2012-2013*

Subject/Code: *Hydraulic Machines/ MPE 227B*
Academic level: *2th ELECTERICAL.*
Date: 4/06 /2014
Time allowed: *3 hours*
Total degree: 90 *marks*

This Exam measures ILOS no.(A5, A14, A16, B2, B4,B5, B6, B13, B16, C5,C12, C15, C17, and C18).

Answer all the following questions

Question-1 *[20marks]*

a) Define: Specific speed, attack angle, lag angle, operating point.

b) Indicate the effect of centrifugal force on the performance of axial and centrifugal pumps. How is it prevented?

c) A centrifugal pump discharges (125 lit. / Sec) of water against a total head of (30 m) and runs at (660 RPM). The outer and inner diameters of its impeller are (60cm and 30 cm) respectively. The area of flow through the impeller is (660 cm^2). The vanes are setback at an angle of (45 degree) to the tangent at exit.
Calculate the hydraulic efficiency and the vane angle at inlet.

Question-2 *[30 marks]*

a) What change can be expected in the "discharge – head" curve when two identical pumps are connection in series and parallel.
b) With the aid of neat sketch, explain the construction and working of an axial flow pump.
c) A centrifugal pump has the following performance characteristics at 875 RPM:

Q (lit. /sec)	75	150	225	300	375	450
H (m)	16.5	16.5	15.9	14.6	12.2	8.2
(%)η	36	63	76	83	80	70

When this pump is interposed in a piping system having a static lift of (9.8 m), it gives a maximum discharge of (300 lit/sec) when rotating at (875 RPM). Estimate the pump speed to give (450 lit/sec) when it is working in the same system. What should be the shaft power required in both cases.

Question-3 *[25 marks]*

a) (i) Define for positive displacement pumps: coefficient of discharge, and volumetric efficiency, and (ii) sketch indicator diagram of reciprocating pumps shown the effects of with air vessel and without air vessel.

b) What is the use of air vessels in reciprocating pumps?

c) A single acting reciprocating pump is to raise a liquid of density (1200kg/m^3) from (2.5m) below pump axis to (9m) above it. The plunger diameter and stroke length are (12.5cm) and (22.5cm), respectively. The suction and delivery pipes are (7.5cm) diameter, and (3.5m) and (13.5m) long, respectively. There is an air-vessel placed on the delivery pipe near the pump axis. But there is no air-vessel on the suction pipe. If cavitations takes place at (0.9kg/cm^2), below atmospheric pressure, find out:

i) the maximum speed with which the pump can run without cavitations,

ii) the horse power required to drive the pump if (f=0.08), iii)% power saved due to fitting an air-vessel in the delivery pipe,

iv) maximum volume of the air-vessel and the pressure of air in the vessel if the free surface of water in vessel is (0.5m) from the pump axis,

v) the rate of flow into or from the air vessel, when the crank makes (40°) with the inner dead centre, and

vi) draw the (H-θ) indicator diagram for the pump.

Quetsion-3 *[15marks]*

a) Prove that the maximum efficiency of Pelton Wheel turbine is

$$\eta_{max} = \frac{1}{2}(1 - k\cos\theta)$$

b) - Show with sketches and brief comments:

i) The velocity diagrams at inlet and outlet of the blades of a typical pelton wheel and Francis turbine.

ii) The methods of power regulation of pelton wheel and Kaplan turbine

c) The following data where obtained from a test on Pelton wheel:

Area of jet = 75 (cm^2). Discharge =172 (lit. / sec); Head at nozzle $H_{eff.}$ = 30 (m); Brake power = 41 (KW); and power absorbed in friction and windage = 2.2 (KW)

Determine:.

i) the energy lost in the nozzle.

ii) The velocity coefficient of the nozzle.

iii) Energy absorbed due to losses in the wheel.

iv)The overall efficiency of the turbine.