	TANTA UNIVERSITY FACULTY OF ENGINEERING DEPARTMENT OF MECHANICAL POWER ENGINEERING			
	EXAMINATION FOR FRESHMEN (2014 YEAR), STUDENTS OF 4th GRADE MECHANICAL POWER			
	COURSE TITLE:	HYDRAULIC MACHINES B		COURSE CODE: MEP 4121
DATE:	MAY 28, 2016	TERM: 2nd	TOTAL ASSESSMENT MARKS: 75	TIME ALLOWED (HOURS): 3

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

Question One: (20 Marks)

a) **A single acting reciprocating of pump handles water. The bore and stroke of the unit are 20 cm and 30 cm. The suction pipe diameter is 12 cm and length is 8 m. The delivery pipe diameter is 12 cm and length is 24 m. f = 0.08. The speed of operation is 32 rpm. Determine the friction power with and without air vessels.**

b) **A single-acting, single-cylinder positive displacement pump, driven at 0.4 rev/s, has a bore of 200 mm and a stroke of 500 mm. The suction and discharge pipes are both 100 mm in diameter. The suction lift is 0.4 m and the suction pipe is 3 m long. The water is discharged at a point 20 m above the pump level by means of a pipe 200 m long, fitted with a large air vessel 20 m from the pump. Calculate the absolute pump cylinder pressures at the (i) start, (ii) end and (iii) mid stroke times for both (a) suction and (b) discharge assuming no slip at the pump and a friction factor of 0.032 for both pipes. Take atmospheric pressure as 10.3 m.**

Question Two, (20 Marks):

a) **The jet velocity in a Pelton turbine is 65 m/s. The peripheral velocity of the runner is 25 m/s. The jet is deflected by 160° by the bucket. Determine the power developed and hydraulic efficiency of the turbine for a flow rate of 0.9 m^3/s. The blade friction coefficient is 0.9. Draw the velocity triangles indicating the values of all velocities on the diagram.**

b) **A Pelton wheel driven by <u>two</u> similar jets transmits 3750 kW to the shaft when running at 375 rev./min. The head from the reservoir level to the nozzles is 200 m and the efficiency of power transmission through the pipelines and nozzles is 90 percent. The jets are tangential to a 1.45 m diameter circle. The relative velocity decreases by 10 percent as the water traverses the buckets, which are so shaped that they would, if stationary, deflect the jet through 165°. Neglecting nozzles losses, find, the efficiency of the runner and the diameter of each jet. Take the mechanical efficiency of the runner as 93.3 percent.**

Question Three, (20 Marks):

a) **In an inward-flow reaction turbine (Francis turbine), the supply head is 12 m and the maximum discharge is 0.28 m^3/s. The runner external diameter is twice the internal diameter and the velocity of flow is constant and equal to $0.15\sqrt{(2gH)}$. The runner vanes are radial at inlet ($\beta_1=90°$) and the runner rotates at 300 rpm. Determine (a) the guide vane angles, (b) the vane angle at exit for radial discharge, (c) widths of the runner at**

inlet and exit. The vanes occupy 10 percent of the circumference and the hydraulic efficiency is 80 percent.

b) A small Francis turbine develops 2555 kW working under a head of 25 m. The overall efficiency is 0.9. The diameter and width at inlet are 1310 mm and 380 mm. At the outlet these are 1100 mm and 730 mm. The runner blade angle at inlet is 135° along the direction of the blade velocity. The whirl is zero at exit. Determine the runner speed, whirl velocity at inlet, the guide blade outlet angle and the flow velocity at outlet. Assume $\eta_{vol} = 0.98$, $\eta_m = 0.97$.

Question Four, (15 Marks):

a) A Kaplan turbine delivers 30 MW and runs at 175 rpm. Overall efficiency is 85% and hydraulic efficiency is 91%. The tip diameter 5 m and the hub diameter is 2 m. Determine the head and the blade angles at the mid radius. The flow rate is 140 m^3/s.

b) A Kaplan turbine develops 2.6 MW under a net head of 7.5 m, it is provided by an elbow type draft tube with a circular inlet of 2.5 m diameter, the inlet is set at height of 1.5 m above the tailrace level. A vacuum gauge connected to the draft tube inlet records a reading of 3.7 m. If the efficiency of the draft tube is 78 percent, calculate the turbine efficiency. If the ratio of area of a circular inlet to the rectangular exit of the draft tube is 1:5, determine the power lost due to friction in the tube.

If the turbine output power was reduced to 1.3 MW under the same rotational speed, estimate the vacuum gage reading.

EXAMINERS	Dr. Ayman Bakry	

Best wishes

قوى ميكانيكية

Tanta University

Second Term Exam

Time Allowed: 3hrs

Hydraulic and Pneumatic Circuits

4th Year Mechanical Power Engineering

Course Code: MEP4229

Total Assessment Marks: 90

Faculty of Engineering

Mechanical Power Engineering Department

June 13, 2016

Please, answer the following questions:

Question (1) **(20Marks)**

1. What is the working principle of a vane pump? What is meant by pressure-compensated vane pump and how does it work? (Illustrate with the help of free sketch).
2. The torque output from a fixed displacement hydraulic motor operating at constant pressure is the same regardless of changes in speed. True or false? Explain your answer.
3. A hydrostatic transmission, operating at 70 bars pressure, has the following characteristics:

Pump	Motor
$V_D = 82\ cm^3$	V_D =?
$\eta_v = 82\%$	$\eta_v = 92\%$
$\eta_m = 88\%$	$\eta_m = 90\%$
$N = 500$ rpm	$N = 400$ rpm

Find:

a) The displacement volume of the motor
b) Motor output torque

Question (2) **(20Marks)**

1. Illustrate with only the help of schematic drawing various types of hydraulic cylinders.
2. Illustrate with only the help of schematic drawing mounting types of hydraulic cylinders.
3. For the system of Fig. 1, determine the hydraulic cylinder force required to drive a 1000N load.

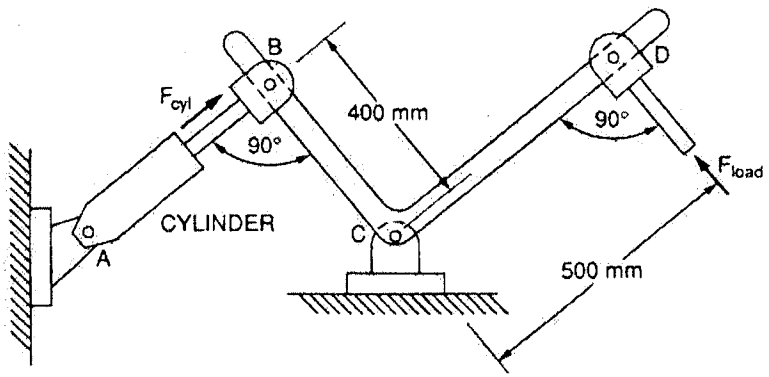

Fig. 1. System of question (2_3)

Question (3) **(15Marks)**

For the circuit of Fig. 1, answer the following questions:

a) Identify marked components in the circuit by mentioning for each component: its name, its operation, and its function in the given circuit
b) Discuss the sequence of operation of cylinders (1) and (2) when the pump is turned on. Assume both cylinders are initially fully retracted

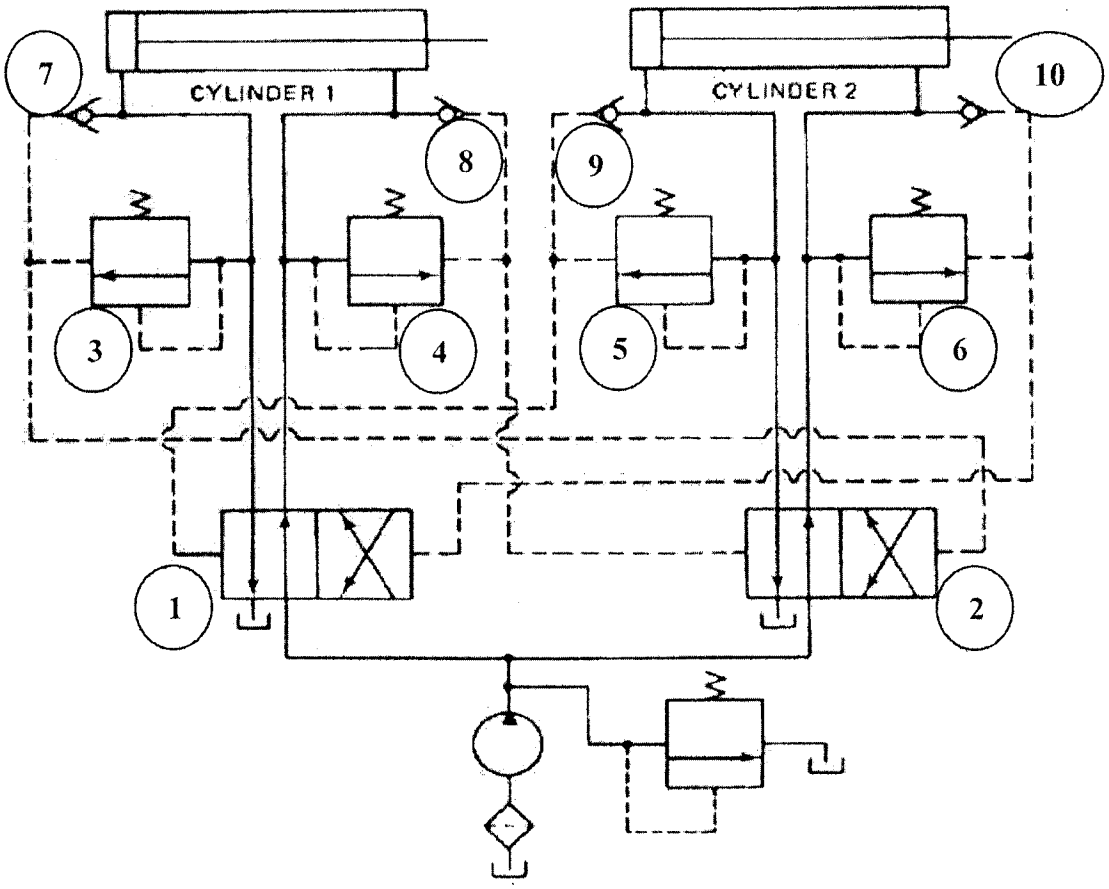

Fig. 2. Circuit of question (3)

Question (4) **(20Marks)**

For the fluid power system shown in Fig. 3, determine the external load (F_1 and F_2) that each hydraulic cylinder can sustain while moving in the extending direction. Take frictional pressure losses into account. The pump produces a pressure increase of 69 bars from the inlet port to the discharge port and a flow rate of 0.00252m^3/s. The following data are applicable:

Kinematic viscosity of oil = 0.000093 m^2/s
Specific weight of oil = 7840 N/m^3
Cylinder piston diameter = 0.203 m
Cylinder rod diameter = 0.102 m
All elbows are 90° with K factor = 0.75

Pipe No.	Length (m)	Diam. (m)	Pipe No.	Length (m)	Diam. (m)
1	1.83	0.0508	6	3.05	0.0254
2	9.15	0.0317	7	3.05	0.0254
3	6.1	0.0317	8	12.2	0.0317
4	3.05	0.0254	9	12.2	0.0317
5	3.05	0.0254			

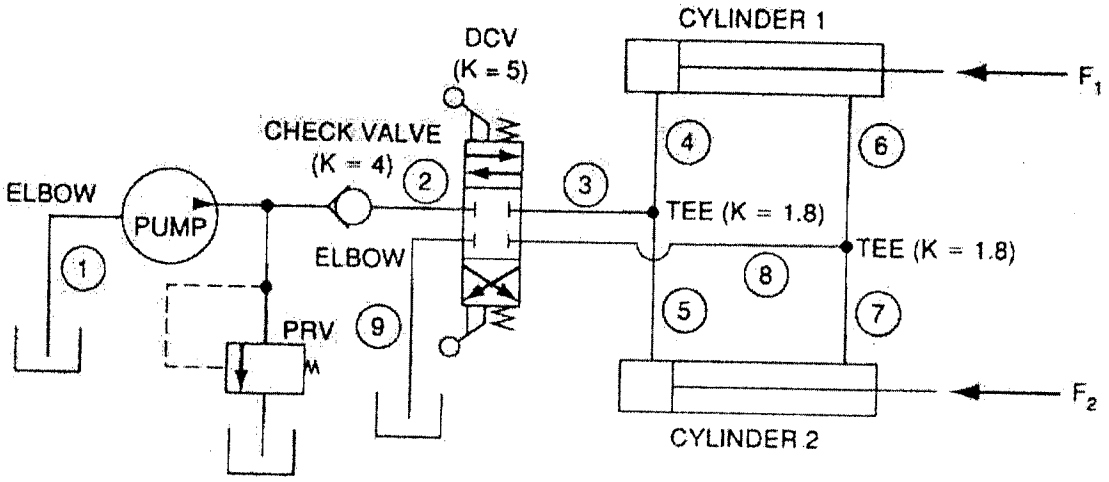

Fig. 3. Circuit for question (4)

Question (5) **(15Marks)**

For the circuit given in Fig. 2, how would be the cylinder extended? Redraw the circuit with considering the actuated positions of valves (1), (2), and (3) to move the cylinder in the extension direction. Illustrate on your drawing the pressure values across both sides of the spool of valve (3).

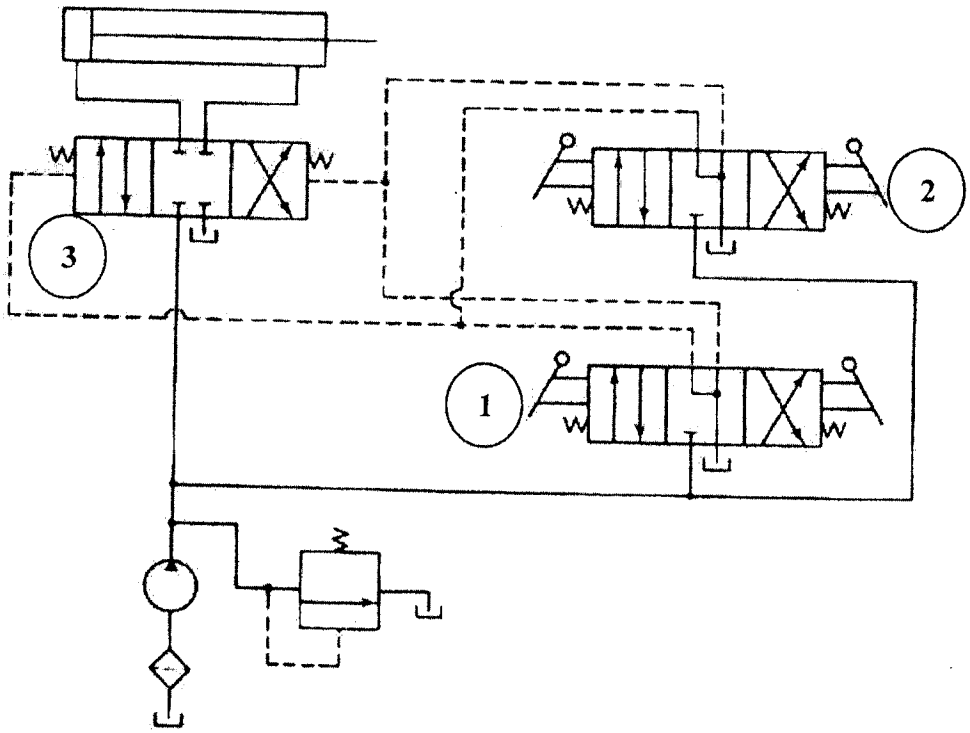

Fig. 4. Circuit of question (5)

Best of Luck

Dr. Omar Mehrez