Course Title	Hydraulic/Pneumatic Systems Design	Academic Year 2023/2024 Spring Term Exam	**Course Code**	MEP331
Year/ Level	**4th Level**			
Date	**01-June- 2024**	No. of Pages (4)	**Allowed time**	**3 hrs**
			Total Assessment Marks: 40	
Remarks: NO REMARKS				

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

Question One, (10 Marks):

a) Sketch the engineering symbol for each of the following hydraulic circuits components and mention its function in one sentence: i- (pilot-operated check valve) ii- (bi-directional rotary hydraulic motor) iii- (counterbalance pressure valve) iv- (solenoid-actuated, closed, spring-centered, 3-position, 4-way valve) v- (needle flow valve).

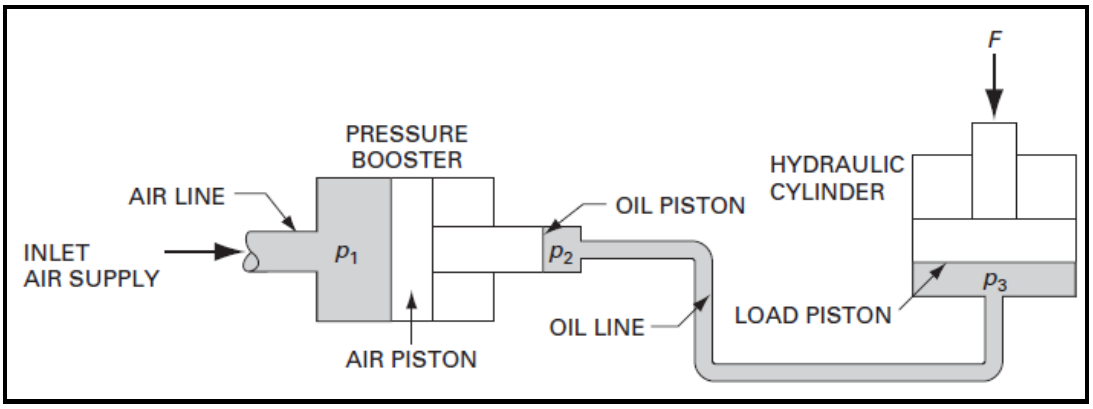
b) Mention the classification of all engineering power systems.

c) Mention the main components which should be contained and included in hydraulic power systems. Sketch a symbolic drawing of a simple hydraulic power system that actuates a double-acting cylinder.

d) For the pressure booster of next Figure, the following data are given:

- **inlet oil pressure (p_1) = 1 MPa**
- **air piston area (A_1) = 0.02 m^2**
- **oil piston area (A_2) = 0.001 m^2**
- **load-carrying capacity (F) = 300,000 N**

Find the required load piston area A_3.



Question Two, (8 Marks):

a) A hydraulic cylinder is to compress a car body down to bale size in 8 s. The operation requires a 3-m stroke and a 40,000-N force. If a 10-MPa pump has been selected, and assuming the cylinder is 100% efficient, find

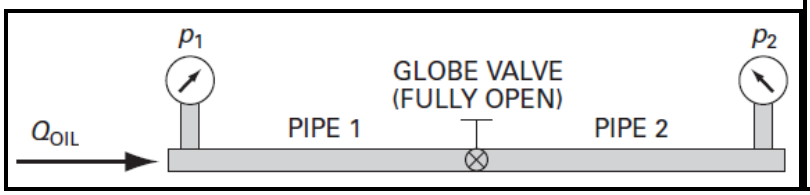
i. The required piston area (m^2)
ii. The necessary pump flow rate (m^3/s)
iii. The hydraulic power (kW) delivered to the cylinder

iv. The output power (kW) delivered by the cylinder to the load
v. Solve parts i, ii, iii, and iv assuming a 400-N friction force and a leakage of 1.0 Lpm. What is the efficiency of the cylinder with the given friction force and leakage?

b) For the system in next Figure, the following data are applicable:

pipe 1: length = 8 m, ID = 25 mm
pipe 2: length = 8 m, ID = 25 mm
The globe valve is 25 mm in size and is wide open.
SG = 0.90, $\nu = 0.0001\ m^2/s$, $Q = 0.0025\ m^3/s$

Find $p_2 - p_1$ in units of bars.



K factors of common valves and fittings.

VALVE OR FITTING		*K* FACTOR
GLOBE VALVE:	WIDE OPEN	10.0
	1/2 OPEN	12.5
GATE VALVE:	WIDE OPEN	0.19
	3/4 OPEN	0.90
	1/2 OPEN	4.5
	1/4 OPEN	24.0
RETURN BEND		2.2
STANDARD TEE		1.8
STANDARD ELBOW?		0.9
45° ELBOW		0.42
90° ELBOW		0.75
BALL CHECK VALVE		4.0

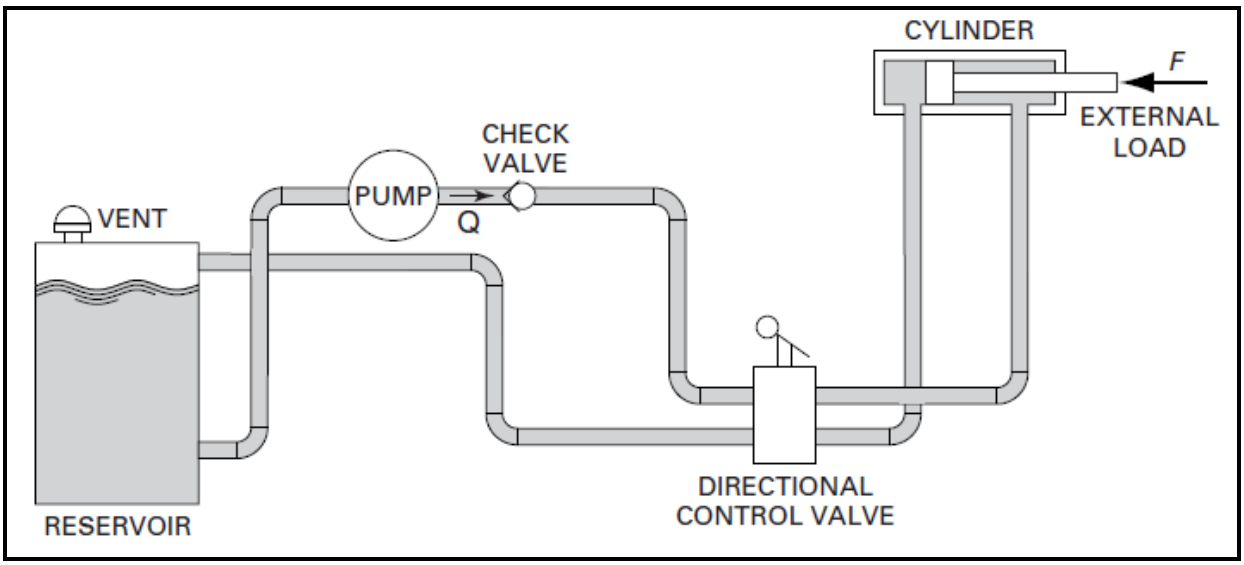
Question Three, (10 Marks):

a) For the fluid power system of next Figure, the following data are given:

cylinder piston diameter = 0.203 m
cylinder rod diameter = 0.102 m
extending speed of cylinder = 0.0762 m/s
external load on cylinder = 178 kN
pump volumetric efficiency = 92%
pump mechanical efficiency = 90%
pump speed = 1800 rpm
pump inlet pressure = −27.6 kPa

The total pressure drop in the line from the pump discharge port to the blank end of the cylinder is 517 kPa. The total pressure drop in the return line from the rod end of the cylinder is 345 kPa. Determine the

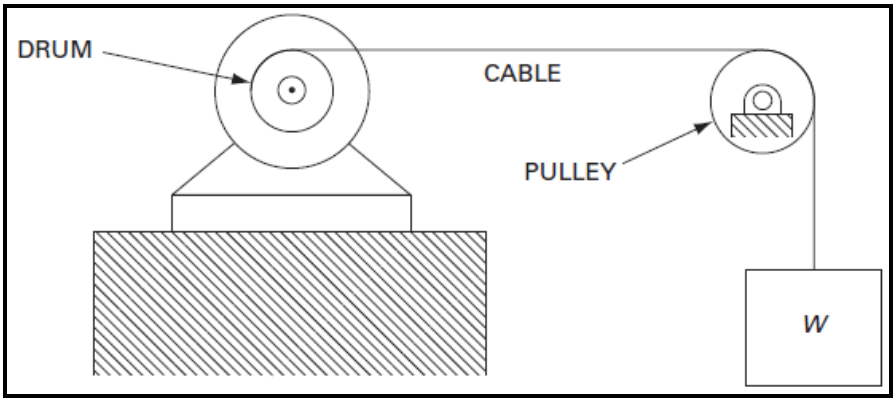
a. Volumetric displacement of the pump
b. Input power required to drive the pump
c. Input torque required to drive the pump
d. Percentage of pump input power delivered to the load



b) The system shown in next Figure, has the following data

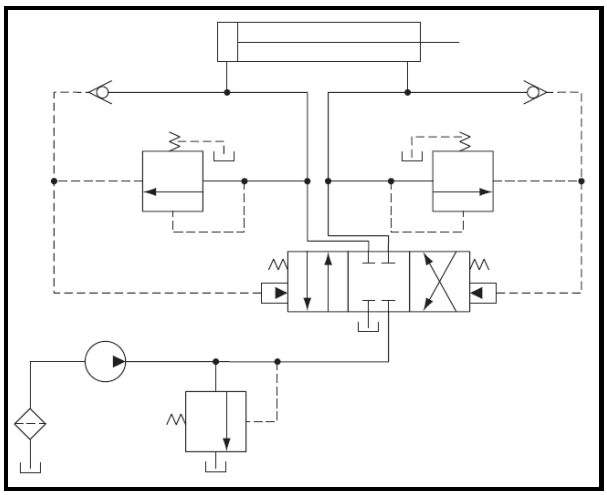
pressure = 1×10^5 kPa
weight of load = 4000 N
motor speed = 30 rpm
drum radius = 0.3 m

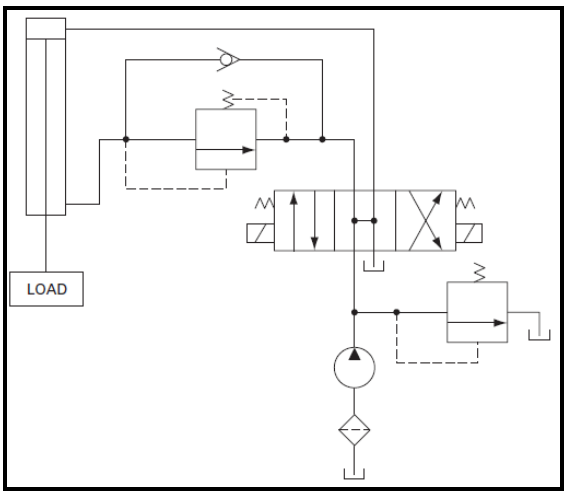
Determine the flowrate in units of m^3/s and the output power of 100% efficient motor in kW.

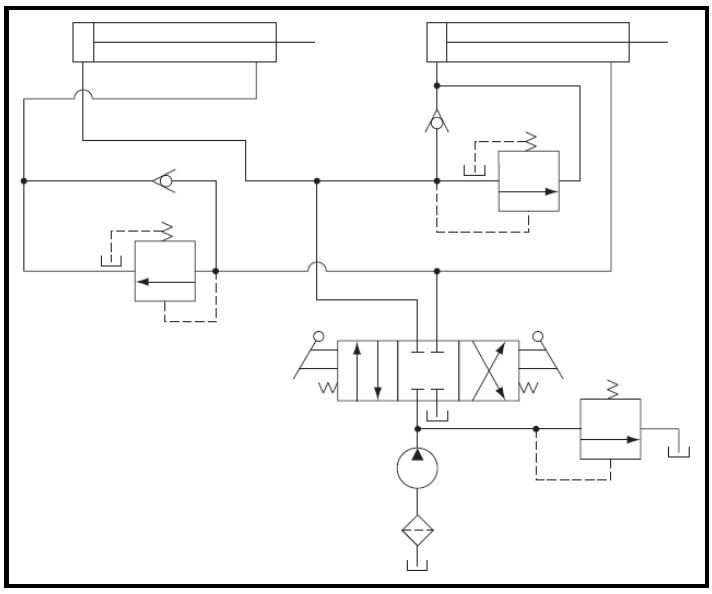


Question Four, (12 Marks):

Redraw (transfer) the following hydraulic systems in your answer sheet. Set the complete specified name (that entirely described its function) of their different components on the copied figures. Then, describe the function of each system during the extension stroke.







End of questions *Good Luck*

EXAMINERS	***Prof. Dr. Ayman Bakry***	