Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2018/2019

COURSE NAME	:	FLUID POWER
COURSE CODE	:	BDE 40503
PROGRAMME CODE	:	BDD
EXAMINATION DATE	:	JUNE / JULY 2019
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWERS **FIVE (5) FROM SIX (6)** QUESTIONS **ONLY**

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

Q1 (a) Power systems are used to transmit and control power. Hydraulic and pneumatic power systems are favorable in terms of power-to-weight ratio as compared to mechanical and electrical power systems. However they also have their cons. Describe the advantages and disadvantages of hydraulic and pneumatic system.

(8 marks)

(b) Describe the different between hydraulic and pneumatics system in form of circuit design.

(12 marks)

Q2 (a) Basic hydraulic circuit system of a machine is shown as in **Figure Q2 (a)**. List the components accordingly and explain the operation of the machine work.

(12 marks)

(b) A pump is a device that moves fluids by a mechanical action. The most common pump used in industrial sector is rotary positive displacement pumps. Name three (3) of the rotary positive displacement pumps and the advantages and disadvantages of the components.

(8 marks)

Q3 The system shown in **Figure Q3** contains a pump delivering high-pressure oil to a hydraulic motor, which drives an external load via a rotating shaft. The following data are given:

$\eta_{m,\ pump} = 90\%$
$\eta_{v,\ pump} = 88\%$
$V_{D,\ pump} = 0.15$ liter
$N_{pump} = 1000$ rpm
Inlet pressure = 26 kPa
$\eta_{m,\ hydraulic\ motor} = 90\%$
$\eta_{v,\ hydraulic\ motor} = 88\%$
Inlet pressure P2 required to drive load = 3500 kPa
Motor discharge pressure = 35 kPa
Pipe diameter = 26.6 mm
Pipe length = 16 m (point 1 to point 2)
$K_{elbow} = 0.75$
$K_{valve} = 4$
Kinematic viscosity, $\nu = 1.25 \times 10^{-4}$ m^2/s
Specific weight, $\gamma = 9807$ N/m^3

The hydraulic motor is 7 m above the pump, evaluate the:

(i) pump flow rate;
(ii) pump discharge pressure;
(iii) input power to drive the pump;
(iv) motor output power;
(v) overall efficiency of the system.

(20 marks)

Q4 (a) A pneumatic vacuum lift system has a total volume of 0.2 m^3 inside the suction cup and associated pipeline leading to the vacuum pump. The vacuum pump produces a flow rate of 3 l/s when turned on. The desired suction pressure is 20 kPa. Determine the time required to achieve the desired vacuum pressure.

(7 marks)

(b) A pneumatic vacuum lift system uses four suction cups, each having a 90 mm and 70 mm of lip-outside and lip-inside diameter respectively. The vacuum system is to lift large steel sheets weighing 1000 N. The total volume inside the cup cavities and associated pipelines up to the vacuum pump is 0.13 m^3. If a factor of safety of 2 is used, what flow rate must the vacuum pump deliver if the time required to produce the desired vacuum pressure is 1 min.

(13 marks)

Q5 (a) Maintenance procedures help to sustain hydraulic system performance, efficiency and life. State three simple maintenance procedures.

(6 marks)

(b) Excessive noise of a hydraulic system is a sign of poor performance. State the remedies for the following cases.

(i) Noisy pump with misaligned coupling;
(ii) Noisy pump due to cavitation problem;
(iii) Relief valve is noisy due to it setting pressure is too low.

(6 marks)

(c) Excessive heat of hydraulic systems due to heated working fluid is undesirable. What are the probable causes and what are the corresponding remedies?

(8 marks)

Q6 (a) A pressure-reducing valve is set to limit the force exerted by a clamping cylinder. The 40 mm bore cylinder must not exert more than 13 kN to prevent damage to the part being held. At the moment the directional control valve (DCV) is shifted to close the clamp cylinder, the supply pressure is 1.9×10^4 kPa.

(i) What pressure drop must the pressure reducing valve maintain?

(ii) If the flow to the clamp cylinder is 5×10^{-4} m^3/s, what orifice coefficient (k) must be developed by the pressure reducing valve?

(8 marks)

(b) Molten metal is poured from a ladle. Total weight of the full ladle is 18000 kg. Just as the pour begins, there is a power failure. Fortunately, the hydraulic circuit has a bank of accumulators charged to 1.8×10^4 kPa that will supply the fluid to move the ladle back to a safe position. Acceleration of the load must be limited to 7.4 m/s^2. An operator manually activates a DCV to direct the accumulator fluid to the 0.18 m diameter cylinder moving the ladle. This operator cracks the DCV and watches the ladle to achieve the correct motion.

(i) What pressure is required to accelerate the load to 7.4 m/s^2?

(ii) What pressure drop across the DCV must be maintained during the period when the load is being accelerated?

(iii) If the force to move the load at constant velocity is FL= 12 kN, what pressure drop across the DCV is required? Assume the accumulator pressure has dropped to 1.3×10^4 kPa by the time the load has just reached constant velocity.

(12 marks)

-END OF QUESTIONS –

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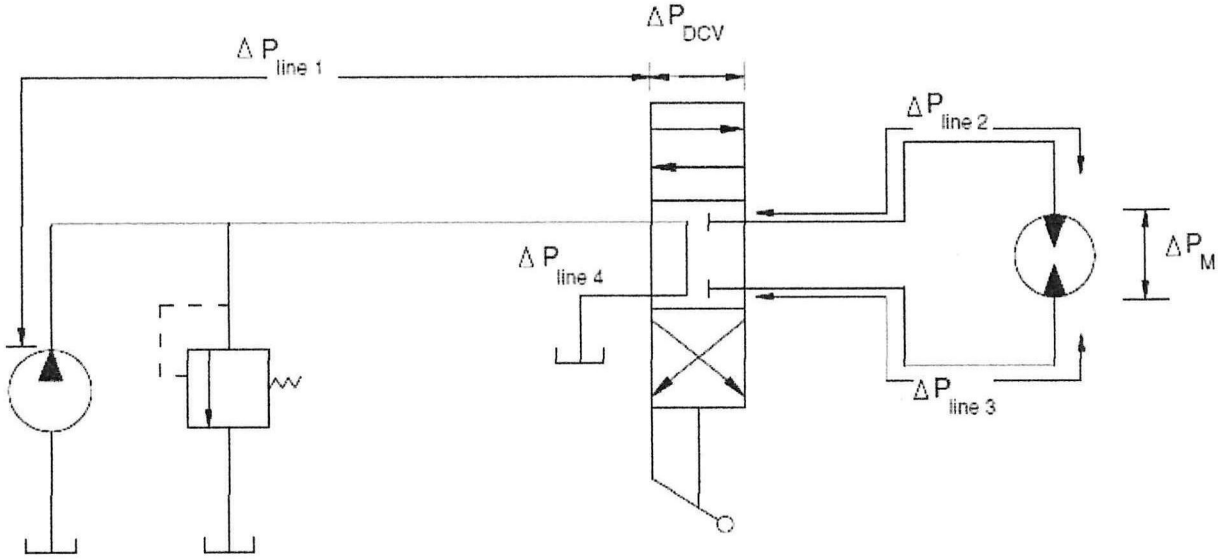

Figure Q1 (b)

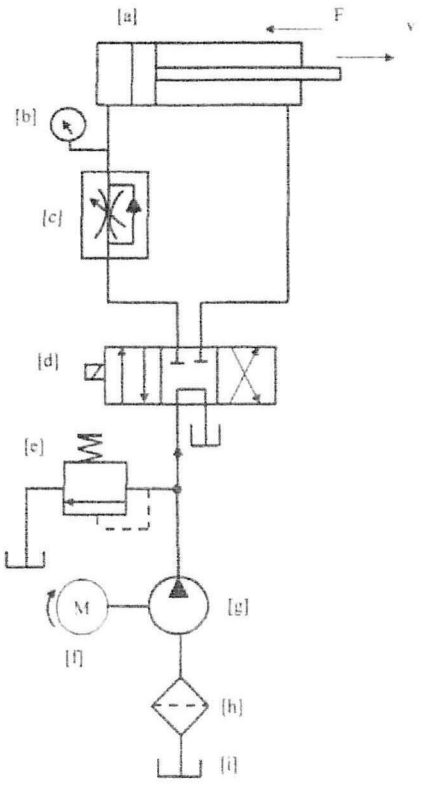

Figure Q2 (b)

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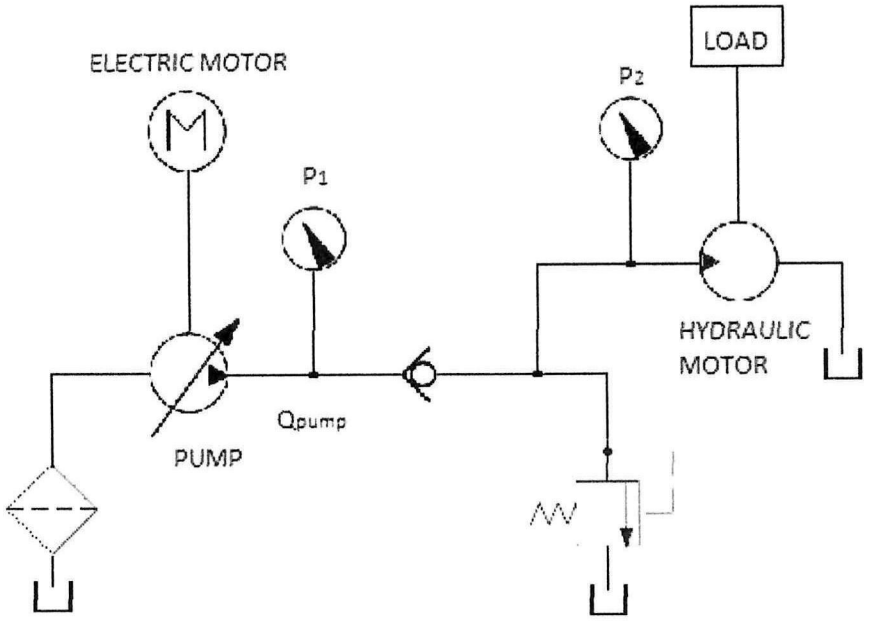

Figure Q3