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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER 2
SESSION 2021/2022**

COURSE NAME : INSTRUMENTATION FOR PROCESS CONTROL
COURSE CODE : BEF 45902
PROGRAMME CODE : BEV
EXAMINATION DATE : JULY 2022
DURATION : 3 HOURS
INSTRUCTION : 1. ANSWER ALL QUESTIONS.
2. THIS FINAL EXAMINATION IS **ONLINE** ASSESSMENT AND CONDUCTED VIA **CLOSE BOOK**.
3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF **FIVE (5)** PAGES

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- Q1** (a) Describe the principle of pipe flow in process industry (6 marks)
- (b) **Figure Q1(b)** shows the powder conveyer system moves with 200 ft/min. The length platform is 7.5 ft and a particular weighing, is 80 lb of powder on the platform. Calculate
- (i) The flow rate of powder, Q in [lb/m] (4 marks)
- (ii) The flow rate of powder, Q in [lb/h] (3 marks)
- (c) Water is pumped through a 1.5-in diameter pipe with a flow velocity, D is 6.5 ft/s, the weight density, ρ is 85 lb/ft³. Calculate
- (i) The valve flow coefficient, C_v (2 marks)
- (ii) The volume of flow rate, v (3 marks)
- (iii) The weight of flow rate, F (3 marks)
- (iv) The volume of flow rate, v_{new} if diameter pipe change to 3.0-in (4 marks)
- Q2** (a) Describe
- (i) **Three (3)** the main issues in valve selection. (6 marks)
- (ii) The steps in selecting a control valve of process control. (8 marks)
- (b) **Figure Q2(b)** shows the hydraulic actuator converts a small force, F_l and working piston force, F_w with F_l is 400 N with 2cm -radius forcing piston, A_l . Calculate
- (i) The working piston force, F_w when the working piston has a radius, A_2 is 10 cm. (4 marks)

- (ii) The hydraulic pressure, P_H .
(4 marks)
- (iii) The hydraulic pressure, $P_{H_{new}}$, if working piston force, $F_{w_{new}}$ is 15 kN, and the radius of working piston, $A_{2_{new}}$ is 5 cm.
(3 marks)

- Q3**
- (a) Describe
 - (i) The purpose of analog signal conditioning
(6 marks)
 - (ii) **Two (2)** signal conditioning issues in process control
(6 marks)
 - (b) Temperature is to be measured in the range of 200°C to 400°C with an accuracy of $\pm 2^\circ\text{C}$. The sensor is a resistance that varies linearly from 300 Ω to 1000 Ω for this temperature range. Power dissipated in the sensor must be kept below 5 mW. Develop analog signal conditioning that provides a voltage varying linearly from 0 to 5 V for this temperature range. The load is a high-impedance recorder.
(13 marks)

- Q4**
- (a) Describe the basic structure of programmable logic controller
(6 marks)
 - (b) Prepare the physical and programmed ladder diagram for the control problem shown in **Figure Q4(b)**. The global objective is to heat a liquid to a specified temperature and keep it there with stirring for 30 min. The hardware has the following characteristics:
 - 1. START push button is NO, STOP is NC.
 - 2. NO and NC are available for the limit switches.The event sequence is
 - 1. Fill the tank.
 - 2. Heat and stir the liquid for 30 min.
 - 3. Empty the tank.
 - 4. Repeat from step 1(10 marks)
 - (c) Describe **three (3)** types of communication protocols used in SCADA or DCS (distributed control system).
(9 marks)

-END OF QUESTIONS-

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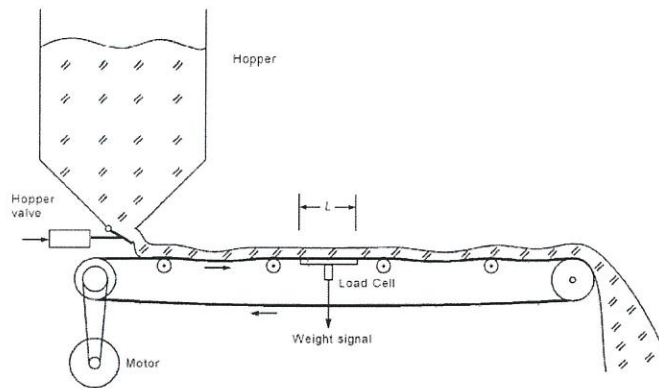


Figure Q1(b)

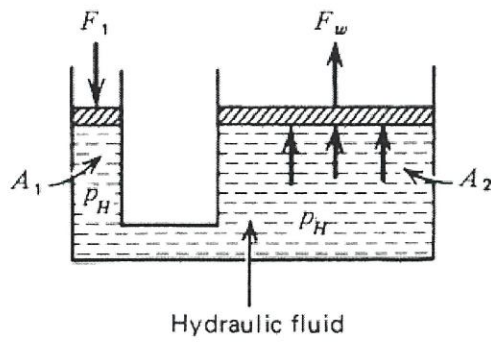


Figure Q2(b)

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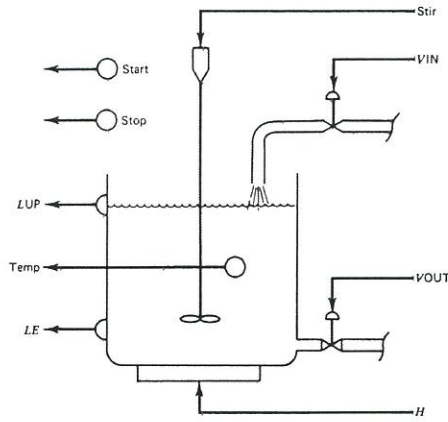


Figure Q4(b)