UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2023/2024

COURSE NAME	:	INDUSTRIAL MACHINERY CONTROL SYSTEM DESIGN
COURSE CODE	:	BBJ 31305
PROGRAMME CODE	:	BBJ
EXAMINATION DATE	:	JULY 2024
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	:	1. ANSWER ALL QUESTIONS.
		2. THIS FINAL EXAMINATION IS CONDUCTED VIA
		☐ Open book
		☒ Closed book
		3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK.

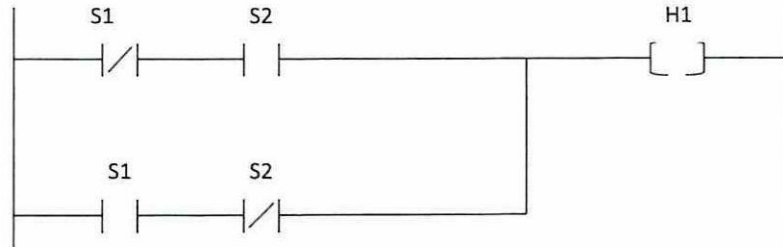THIS QUESTION PAPER CONSISTS OF **FIVE (5)** PAGES

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Q1. (a) List **three (3)** types of PLC languages in accordance with IEC61131-3

(3 marks)

(b) **Figure Q1.1** shows a ladder diagram for simple logic control of two normally open push buttons (S1 and S2) and a light indicator (H1).
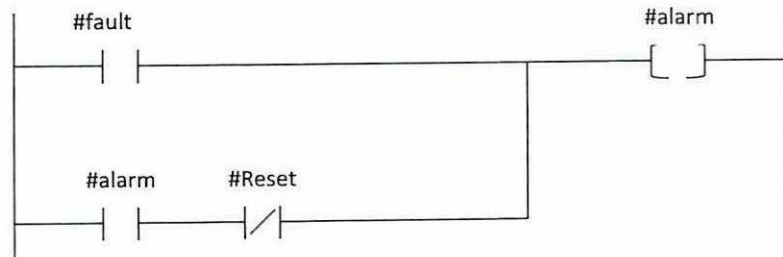

Figure Q1.1

Explain all possible signal assignments of push buttons for the program in which the light indicator will be switched on and any possible signal assignments of push buttons for the program in which the light indicator will be switched off.

(6 marks)

(c) **Figure Q1.2** shows a ladder diagram for a control system for alarm events in case of any error or fault triggered in an industrial machinery system.

Figure Q1.2

Explain the operation of the ladder diagram based on **Figure Q1.2**

(6 marks)

(d) Based on the previous question, **Q1(c)**, develop an alternative solution of the ladder diagram that provides the same operation result.

(4 marks)

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(e) **Figure Q1.3** illustrates the control system of a bulk material mixing system consisting of a normally open push button (S1) and a normally open selector detent switch (S2). **Figure Q1.4** shows the electro-pneumatic circuit diagram for the system. Once the appropriate silo has been selected using the selector detent switch (S2), pressing the push button (S1) opens the silo accordingly. Both silos use single solenoid valves to control double-acting cylinders respectively. The cylinders are extended in the initial position. Design the control system using a ladder diagram to carry out this process.
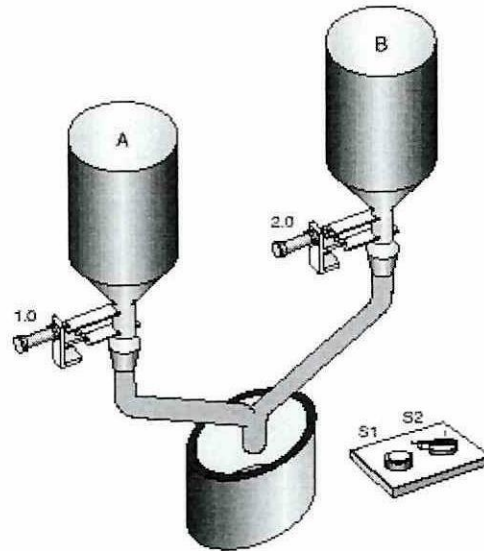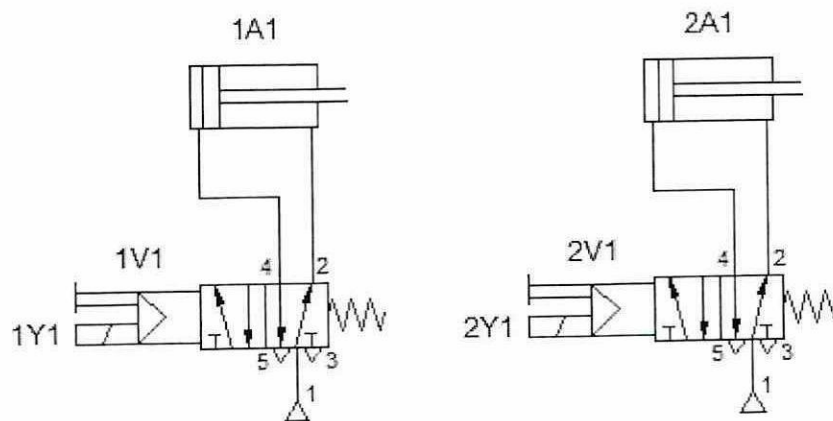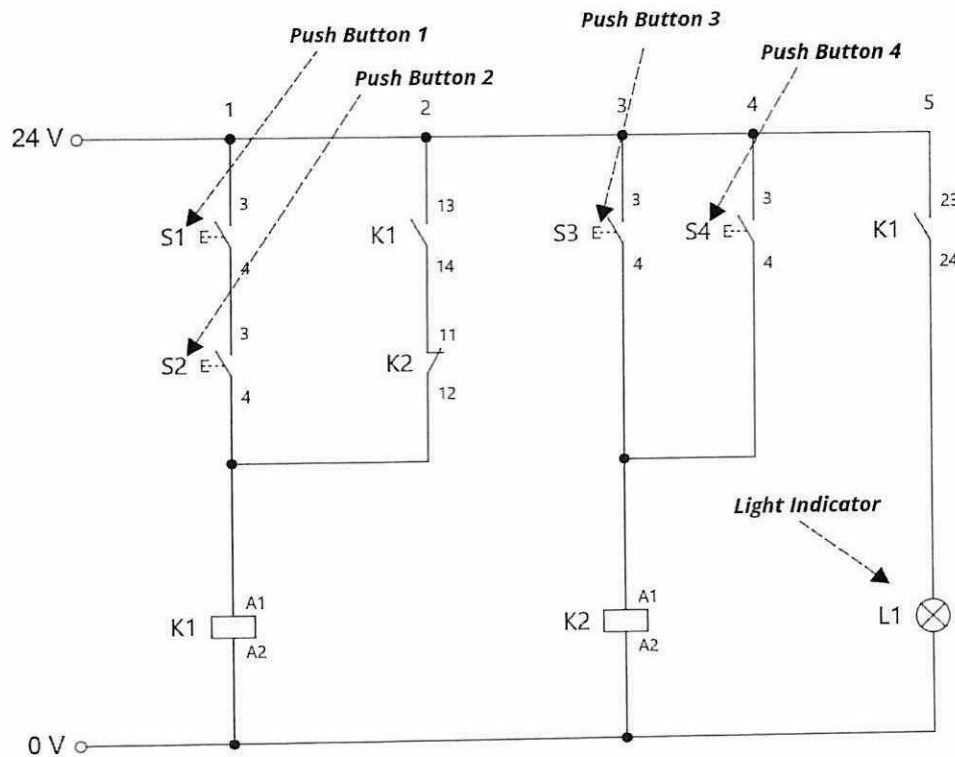
(6 marks)

Figure Q1.3

Figure Q1.4

Q2. (a) List **two (2)** types of signal edges.

(2 marks)

(b) Explain the signal edges operation in PLC programming in accordance with IEC61131-3.

(4 marks)

(c) Explain the Time Pulse (TP) Timer operation in PLC programming in accordance with IEC61131-3.

(4 marks)

(d) Sketch the timing diagram for the Time Pulse (TP) Timer.

(5 marks)

(e) **Figure Q2.1** shows the electrical circuit diagram of manual control (without the use of PLC) of the stamping process machine. Develop a control system using a ladder diagram to provide the same operation result by including a suitable function block, either RS block or SR block, that complies with the IEC61131-3 standard.

(10 marks)

Figure Q2.1

Q3. (a) List **three (3)** types of sensors.

(3 marks)

(b) Explain how the vacuum generator works.

(6 marks)

(c) Sketch the airflow operation of the vacuum generator.

(5 marks)

(d) List **three (3)** functions of the pressure sensor.

(3 marks)

(e) Explain **two (2)** modes of operation of pressure sensors.

(8 marks)

Q4. (a) List **three (3)** characteristics of the control system based on the type of signal processing.

(3 marks)

(b) List **two (2)** types of signal forms.

(2 marks)

(c) Explain **four (4)** disadvantages of the microcontrollers, which are the reason that microcontrollers are not being used in place of PLC applications.

(8 marks)

(d) Explain the definition of the closed-loop control system according to DIN 19226.

(4 marks)

(e) Explain the example of closed-loop control application in Water Tank Levelling and Heating process automation.

(8 marks)

-END OF QUESTIONS –

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