



UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER II
SESSION 2023/2024**

- COURSE NAME : INDUSTRIAL AUTOMATION
- COURSE CODE : DAE 31203
- PROGRAMME CODE : DAE
- EXAMINATION DATE : JULY 2024
- DURATION : 3 HOURS
- INSTRUCTIONS :
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 SIX (6) PAGES

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Q1 Industrial Control System can be defined as the process of following a predetermined sequence of operations with little or no human labour, using specialized equipment and devices that perform and control manufacturing processes.

(a) Present the basic process in the Automated Control System with the suitable illustration block diagram.

(4 marks)

(b) Describe each of the elements in the basic process in the Automated Control System sketched in Q1(a).

(6 marks)

(c) Differentiate between mechanization and automation.

(4 marks)

(d) Describe the type of robot used in the Automated Control System.

(6 marks)

(e) In your opinion, is Industrial Revolution 4.0 (IR 4.0) applied and achieved in small and medium industries (SMEs) in Malaysia? Produce support statements on the opinion.

(5 marks)

Q2 Industrial automation is built from different components of technology. This distinct technology is applied and embedded in input, output, and control elements.

(a) Input elements can be categorized as switches and sensors. State four (4) types of level switch.

(4 marks)

(b) There are three (3) types of stepper motor in industry. Compare the characteristics of Permanent Magnet Stepper Motor and Variable Reluctance Stepper Motor. Any illustrated graphics are allowed to explain the answer.

(6 marks)

(c) A Pneumatic System consists of three (3) main components. Describe the function of each component to generate the expected output.

(6 marks)

(d) An Electro-Pneumatic System as showed in **Figure Q2.1** operates a unique sequence to extend and retract the Double Acting Cylinder (DAC).

(i) Indicate the types of both timers implemented in the system.

(2 marks)

(ii) Show the full operation and sequence of the system when Switch S1 is pressed and released.

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(7 marks)

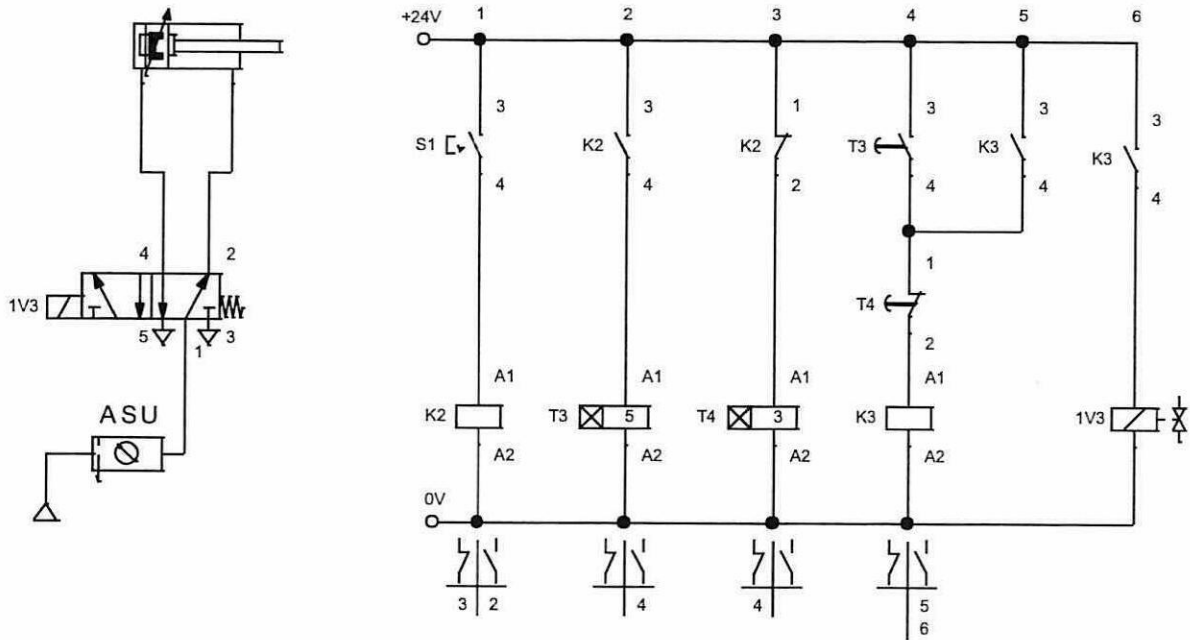


Figure Q2.1 An Electro-Pneumatic System in Industry

Q3 A Programmable Logic Controller (PLC) plays the primary role in automated control systems in the manufacturing industry. Therefore, PLC can be found in the different physical constructions with various programming languages.

(a) Define the terminology of PLC.

(4 marks)

(b) Give the control type of PLC and indicate the example of function for each control type.

(6 marks)

(c) Based on the **Figure Q3.1**, sheets of paper are to be cut to size using a cutting device. The cutting blade is advanced and the sheet of paper is cut by pressing two push button switches. After releasing one push button switch, the cutting blade is returned to its start position. Prepare the ladder diagram of the system by making the cutting blade (CB) as the system's output.

(5 marks)

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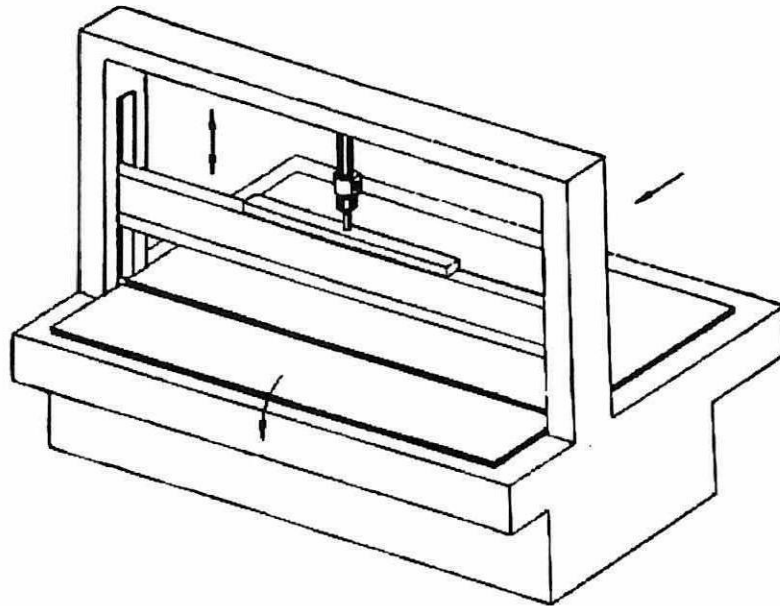


Figure Q3.1 A Cutting Device for Paper

- (d) An electric circuit in the Electro-Pneumatic Diagram has the same concept as the Ladder Diagram. Construct the corresponding Sequential Function Chart (SFC) for the following electro-pneumatic circuit in **Figure Q3.2**.

(10 marks)

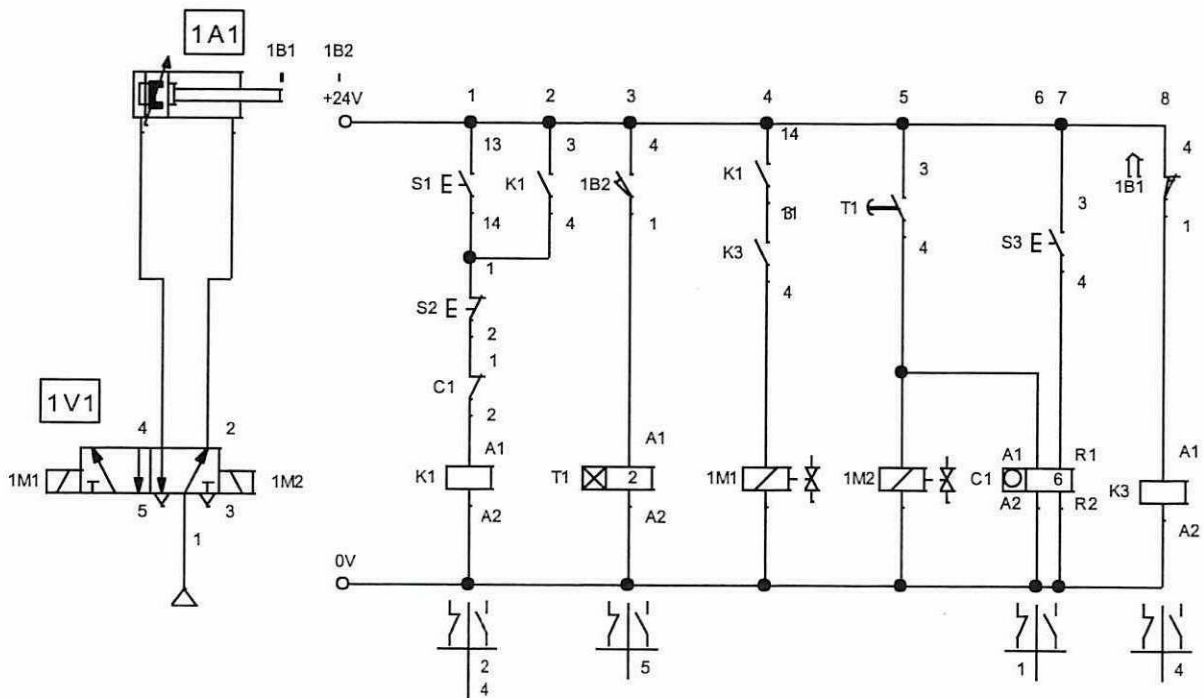


Figure Q3.2 An Electro-Pneumatic Circuit with Oscillating Motion

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Q4 In a production line, an automation system plays a vital role in increasing the production output in the manufacturing industry. Robots are another component in an automation system that speeds up a process or makes work difficult for human operators.

(a) Define the terminology of automation.

(2 marks)

(b) Discuss the utilization of fixed and programmable automation in terms of production quantity.

(4 marks)

(c) **Figure Q4.1** shows one type of industrial robot.

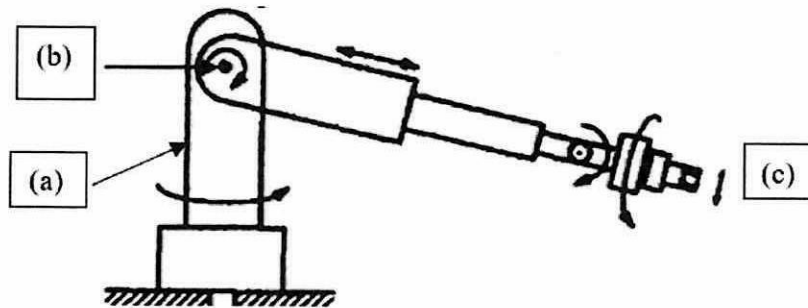


Figure Q4.1 An Arm Robot Applied in Industrial

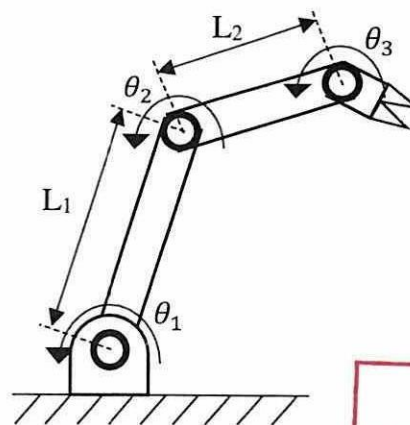
(i) Name the labelled part of (a), (b) and (c).

(3 marks)

(ii) Discuss two (2) factors that need to be considered by a company to utilize robot manipulator in the manufacturing process.

(4 marks)

(d) **Figure Q4.2** shows a manipulator robot having 3 degree of freedom.



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Figure Q4.2 A Manipulator Robot

- (i) Assign each joint of the robot with a frame corresponding to the (x,y,z) axis.
(6 marks)
- (ii) Complete the link parameters of the robot using Denavit-Hartenberg convention.
(6 marks)

- END OF QUESTIONS -

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