Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2022/2023

COURSE NAME	:	INDUSTRIAL AUTOMATION SYSTEM
COURSE CODE	:	BEJ 34103
PROGRAMME CODE	:	BEJ
EXAMINATION DATE	:	JULY / AUGUST 2023
DURATION	:	3 HOURS
INSTRUCTION	:	1. ANSWER ALL QUESTIONS 2.THIS FINAL EXAMINATION IS CONDUCTED VIA **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 **SEVEN (7)** PAGES

Q1 (a) Based on **Figure Q1(a)**, speculate the role of automation and control technologies in a production system.

(5 marks)

(b) With respect to industrial automation and control technologies,

(i) Illustrate the basic elements of an automated system using a block diagram.

(4 marks)

(ii) Based on the three (3) types of automation, propose an example of a suitable product to be applied in each type of automation.

(6 marks)

(c) As the scale of production grows and the competition aggregates, for example a Samsung tab; the industry has looked for a better solution for the management of all resources including automation.

(i) Explain the concept of Computer Integrated Manufacturing (CIM) to help in the solution.

(4 marks)

(ii) Recently, Industry 4.0 has become the current trend of automation and data exchange in manufacturing technologies. Discuss Industry 4.0 if the concept benefits all industries to compete in the market.

(6 marks)

Q2 (a) A fiberboard production is divided into several stages:

1. Wood chips are steamed to soften them for defibration using a boiler system.
2. A small amount of paraffin wax is added to the steamed chips and they are transformed into a fluffy fiber.
3. The fibers are arranged into a uniform "mat" on a conveyor belt.
4. This mat is pre-compressed and then hot-pressed.
5. Hot-pressing activates the adhesive and glues the fibers together.
6. Lastly, the board is then cooled, trimmed, sanded, and maybe veneered or laminated.

Investigate the criteria of the sensor selection of the automation and control for the fiberboard production at the last stages. The engineer is advised to justify the criteria based on the working environment and the potential hazards.

(6 marks)

(b) Construct a relay control circuitry for a sliding door using a double-acting pneumatic cylinder as illustrated in **Figure Q2(b)**. The electrical components include pushbuttons (momentary type), relays (2P2T), a 5/3 ways double coil, and a DC24V power supply.

(4 marks)

(c) **Figure Q2(c)** shows a two-level S-type cargo lift. You are required to propose and design the system.

(i) Re-draw and mark the locations of the sensors and actuators including the user panel. (Name them properly).

(6 marks)

(ii) Suggest types of sensors and actuators marked at **Q2(c)(i)**.

(3 marks)

(iii) Justify your selection at these locations.

(6 marks)

Q3 (a) List five (5) reasons why industrial robots play an important role in the manufacturing industry.

(5 marks)

(b) **Figure Q3(b)** shows an industrial robot with three (3) joints end effector attached to it:

(i) Deduce the degree of freedom the robot possesses and robot process operation.

(2 marks)

(ii) Categorize the robot body-and-arm configuration and the joint notation scheme.

(3 marks)

(iii) Establish component A – D in the figure with their function.

(8 marks)

(c) **Figure Q3(c)** shows a separate conveyor to divert one (1) part out of every twenty (20) to quality control line automatically for inspection purpose. The operation is as follow:

A Start/Stop push button is used to turn the conveyor motor on and off.
A proximity sensor counts the parts as they pass by on the conveyor.
When a count of 20 is reached, the counter's output activates the gate solenoid, diverting the part into the inspection line.
The gate solenoid is energized for 2 seconds, which allows enough time for the part to continue to the quality line.
The gates return to its normal position when the 2 seconds time period ends.
The counter reset to 0 and continues accumulate counts.
A reset pushbutton is provided to reset the counter manually.

(i) Develop the Grafcet for the process description.

(7 marks)

Q4 (a) List four (4) benefits of using a programmable logic controller (PLC) in industrial automation for production.

(4 marks)

(b) **Figure Q4(b)** shows a drilling machine for holes opening on object A, manually placed by an operator. The machine has a movable cover to protect the operator from lubricating liquids and insertion of the hand during the operation, where:
C_1 = cylinder that lowers or raises the chuck
C_2 = cylinder that lowers or raises the protective cover
S_0 = sensor detecting the lower position of the piston C1 when the drilling has finished
S_1 = sensor detecting the presence of an object in the drilling position
S_2 = sensor detecting the lower position of the protective cover.
The stand-by control panel is the two-button control box with which the machine is set to a stand-by status. The light indicator expressing the "stand-by ON" status.
The operation control panel is a two-button control box in a double function to start or stop the drilling procedure.
The machine operation is as follow:
1. The initial position of the two pistons is "up'.
2. Machine starts to operate when "Stand-by ON" button is pressed, and indicator lights up.
3. When sensor S1 detects an object placed on the base, only the drilling can be started.
4. When the two buttons "start drilling" are pressed at the same time (requires both hands of the operator for safety reason), the protective cover (activation of the relay C_2) starts to lower. If the two buttons are released, the cover returns to its original position.
5. When the protective cover is brought to its final position, it is detected by sensors S2 and then the piston C_1 (activation of the relay C_1) starts to lower, while simultaneously the drilling head starts its rotation. At this stage, the two "start drilling" buttons need not to be pressed because the protective cover has already been lowered.
6. Piston C_1 and the drilling head press down the object until drilling is complete when sensor S_0 is activated.
7. Once S_0 is activated, the drilling head and the protective cover return simultaneously to the initial position. Then the machine is ready to accept new objects.
8. If at any time, either the two "stop drilling" buttons are pressed simultaneously or the "Stand-by OFF" button is pressed alone, the process stops, and the two pistons return to the "up" position.

(i) Analyze the input and output of the machine and set the address accordingly.

(11 marks)

(ii) Construct the ladder diagram for the operation and indicate the address clearly.

(10 marks)

-END OF QUESTIONS –

FINAL EXAMINATION

SEMESTER / SESSION : SEM II 2022/2023
COURSE NAME : INDUSTRIAL AUTOMATION SYSTEM
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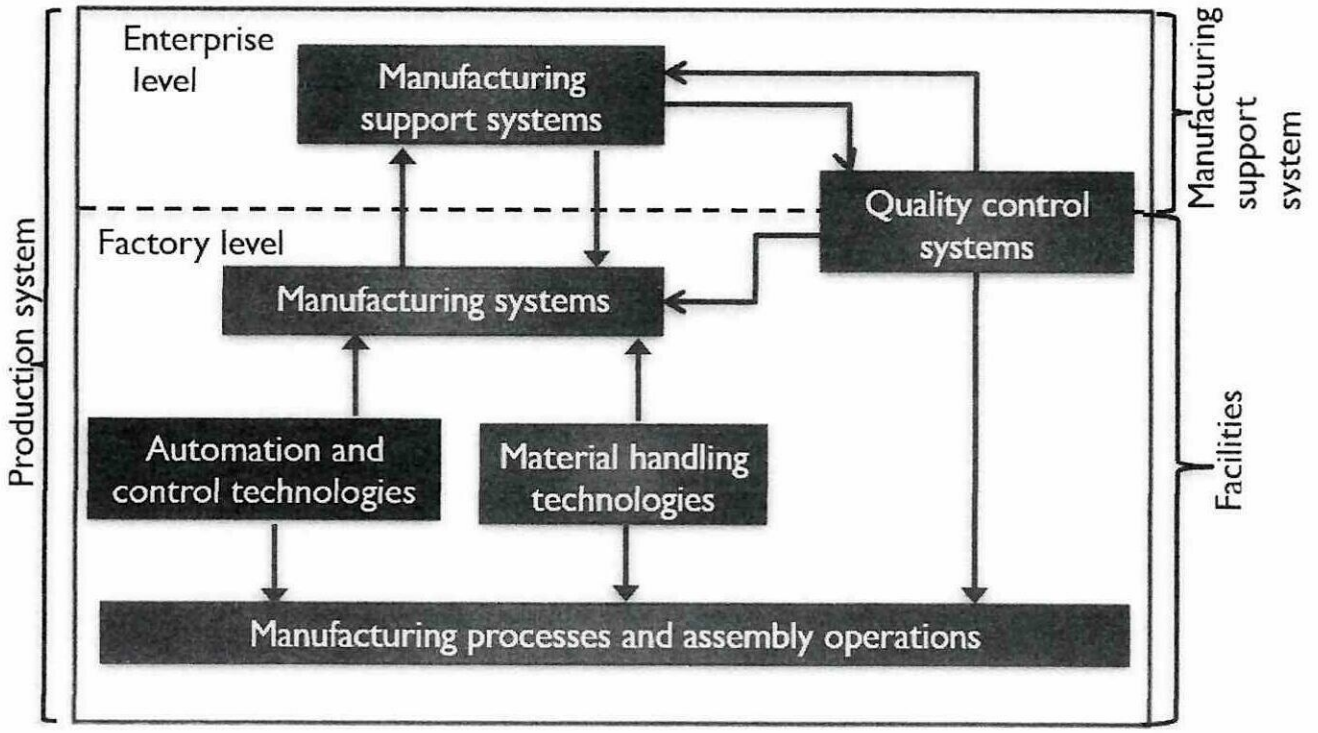

Figure Q1(a)

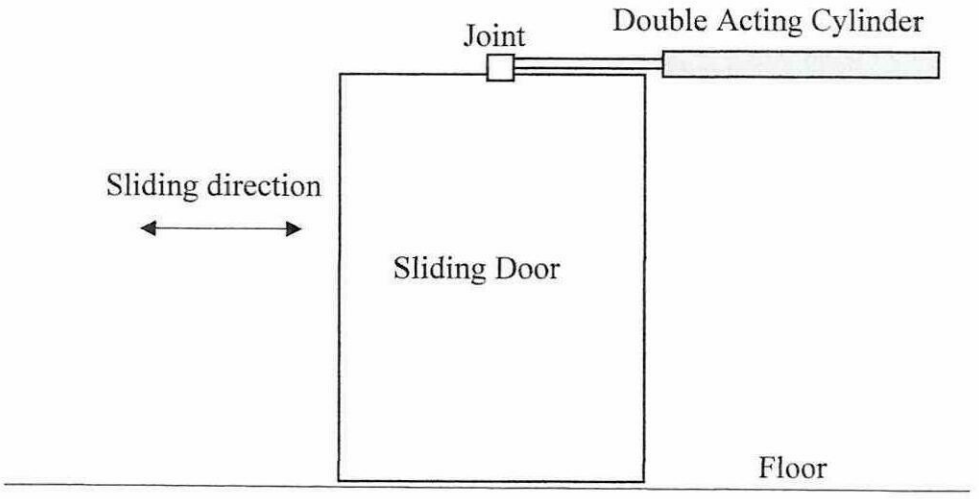

Figure Q2(b)

FINAL EXAMINATION

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COURSE NAME : INDUSTRIAL AUTOMATION SYSTEM
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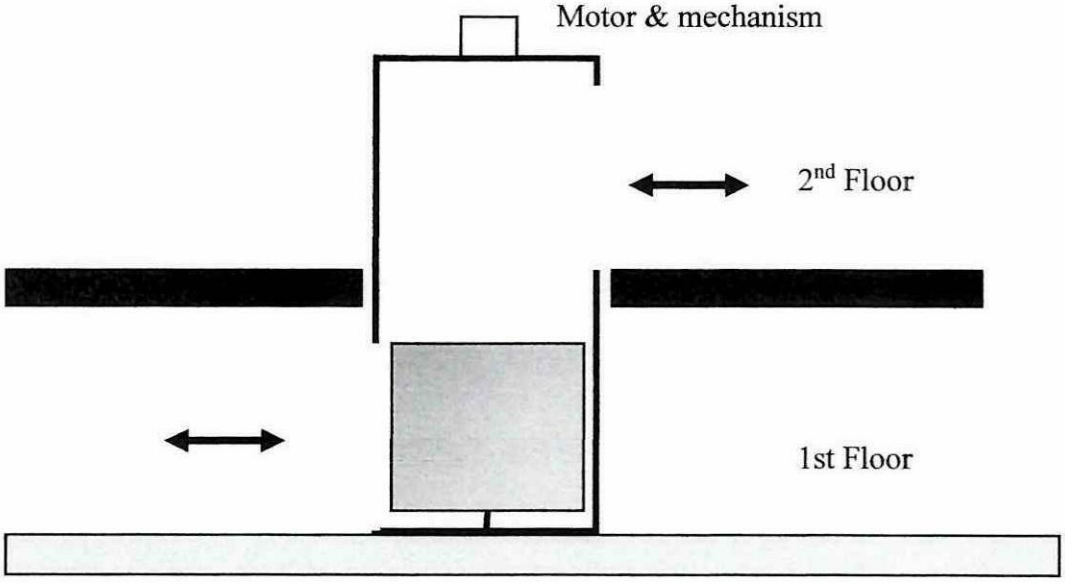

Figure Q2(c)

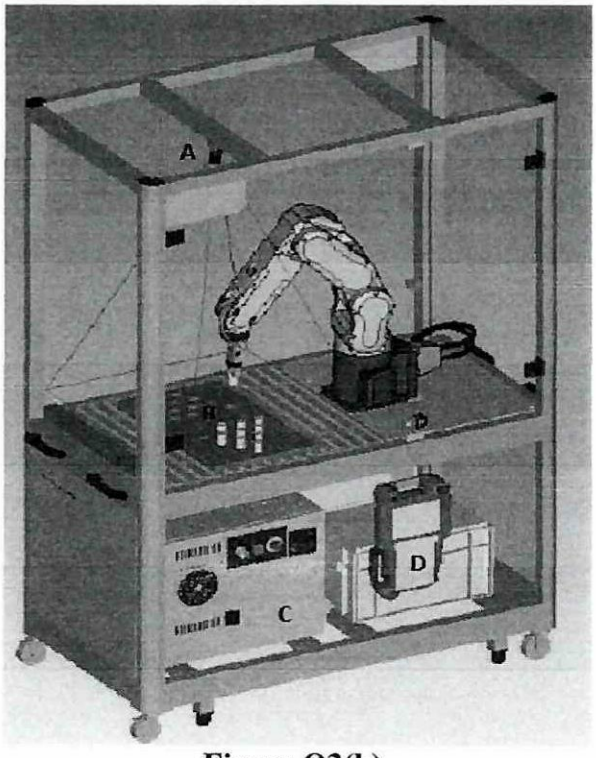

Figure Q3(b)

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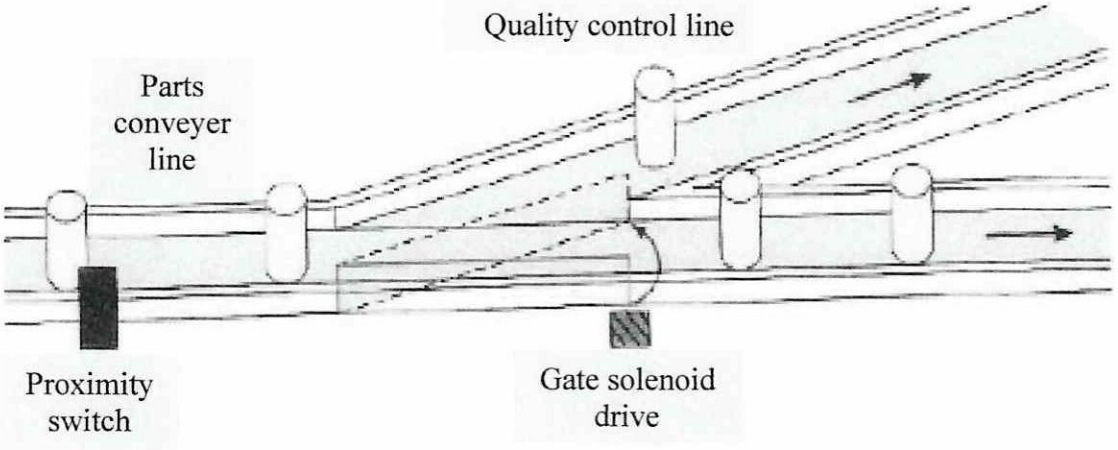

Figure Q3(c)

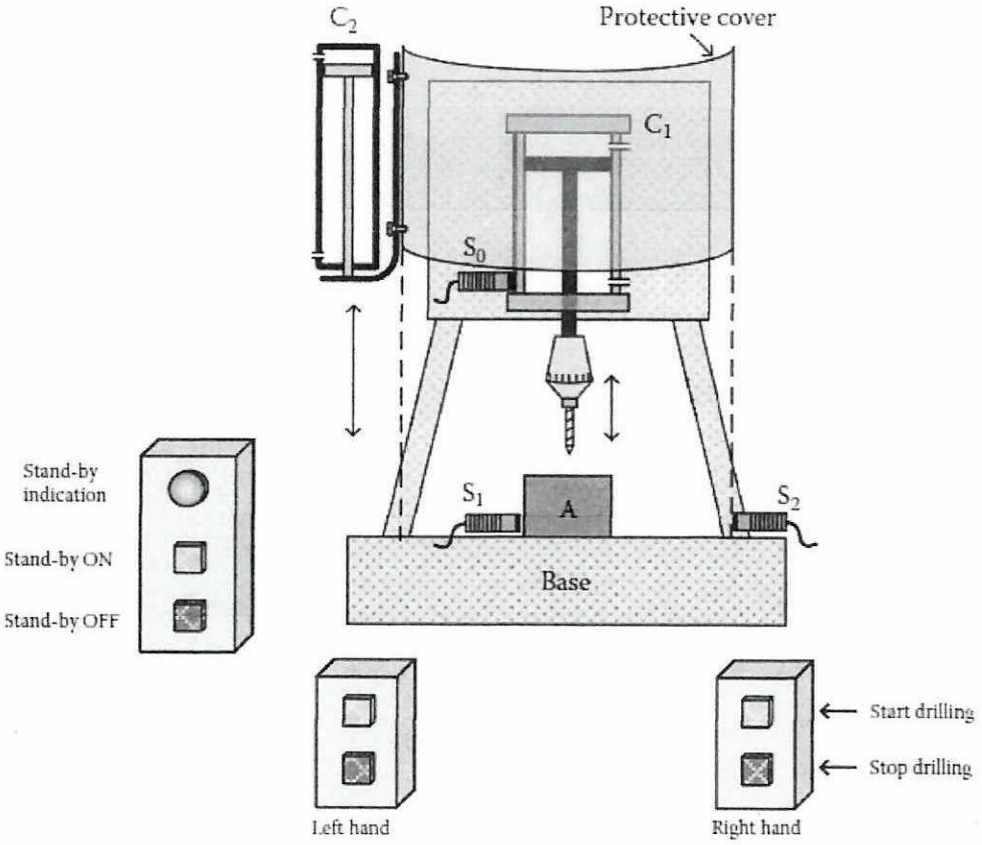

Figure Q4(b)