Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2021/2022

COURSE NAME	:	INDUSTRIAL AUTOMATION SYSTEM
COURSE CODE	:	BEJ 34103
PROGRAMME CODE	:	BEJ
EXAMINATION DATE	:	JULY 2022
DURATION	:	3 HOURS

INSTRUCTION

1. ANSWER ALL QUESTIONS
2. THIS FINAL EXAMINATION IS AN **ONLINE** ASSESSMENT AND 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 **EIGHT (8)** PAGES

TERBUKA

Q1 (a) Explain the role of automation and control technologies in a production system.
(5 marks)

(b) In the industrial automation and control technologies,

(i) Explain three basic elements of an industrial automated system.
(3 marks)

(ii) As a newly hired automation engineer in the semiconductor industry, you are responsible to improve the automation system in the factory. Investigate how you can deliver the task.
(12 marks)

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

(b) **Figure Q2(b)** 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) Propose types of sensors and actuators marked at **Q2(b)(i)**.
(4 marks)

(iii) Justify your selection at these locations.
(6 marks)

Q3 (a) State **three (3)** reasons industrial robot plays an important role in the manufacturing industry
(3 marks)

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

(i) Examine the degree-of-freedom the robot possess and robot process operation.
(2 marks)

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

(iii) Analyze component A – D in the figure, name it and state their functions.
(8 marks)

(iv) Discover the robot operating space with an appropriate diagram representation indicating the coverage angle.
(4 marks)

TERBUKA

Q4 (a) Industrial production involves numerous cycles of repetitive and sequential operations. From time to time, the automation sequences could be modified or altered to meet the production need in short notice. Identify **four (4)** benefits of using a programmable logic controller (PLC) in industrial automation for production.

(4 marks)

(b) **Figure Q4(b)** shows a separate conveyor to divert one (1) part out of every twenty (20) parts to the quality control line automatically for inspection purposes. The operation is as follows:

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

(i) Develop the Grafcet for the process description.

(7 marks)

(ii) Propose your preferred process description method and justify your answer.

(3 marks)

(c) Draw the diagram of Computer Aided Design (CAD)/ Computer Aided Manufacturing (CAM) and Computer Integrated Manufacturing (CIM) and explain the concept of CIM.

(6 marks)

Q5 **Figure Q5** 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 standby control panel is the two-button control box with which the machine is set to a standby status. The light indicator expresses the "stand-by ON" status.
The operation control panel is the two-button control box in a double function to start or stop the drilling procedure.

TERBUKA

The machine operation is as follows:
1. The initial position of the two pistons is "up'.
2. Machine start to operate when the "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 reasons), 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 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 a new object.
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

(a) Analyse the input and output of the machine and set the address accordingly (10marks)

(b) Construct the ladder diagram for the operation and indicate the address clearly (10 marks)

-END OF QUESTIONS –

TERBUKA

FINAL EXAMINATION

SEMESTER / SESSION : SEM II 2021/2022 PROGRAMME CODE : BEJ
COURSE NAME: INDUSTRIAL AUTOMATION SYSTEM COURSE CODE : BEJ 34103

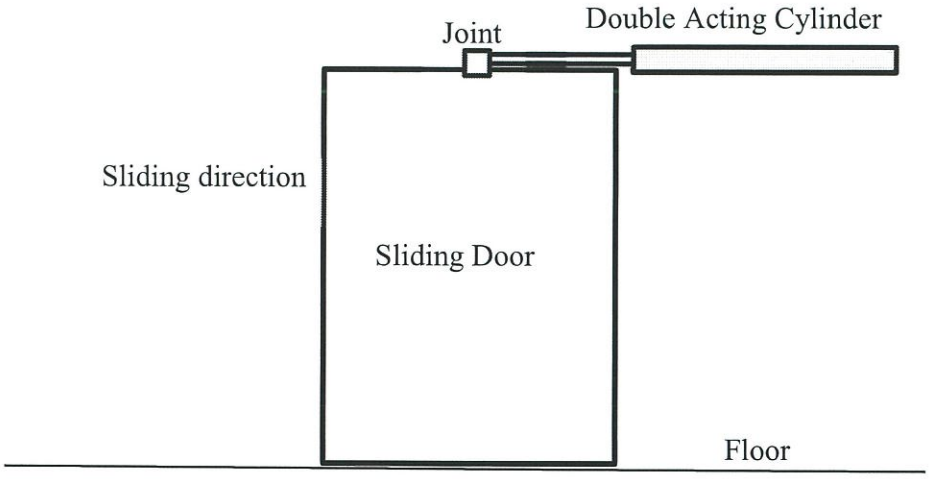

Figure Q2(a)

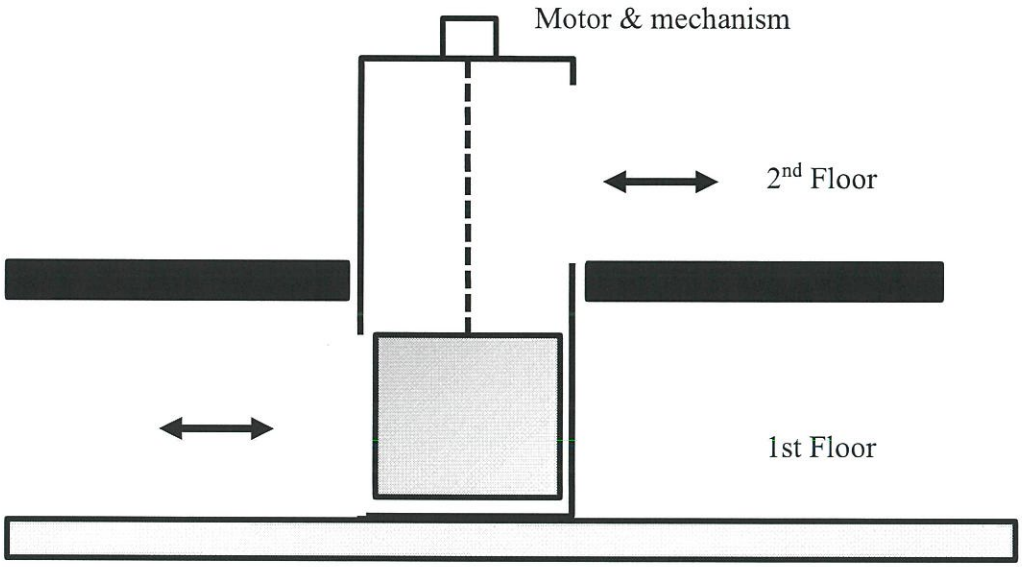

Figure Q2(b)

TERBUKA

FINAL EXAMINATION

SEMESTER / SESSION : SEM II 2021/2022
COURSE NAME: INDUSTRIAL AUTOMATION SYSTEM

PROGRAMME CODE : BEJ
COURSE CODE : BEJ 34103

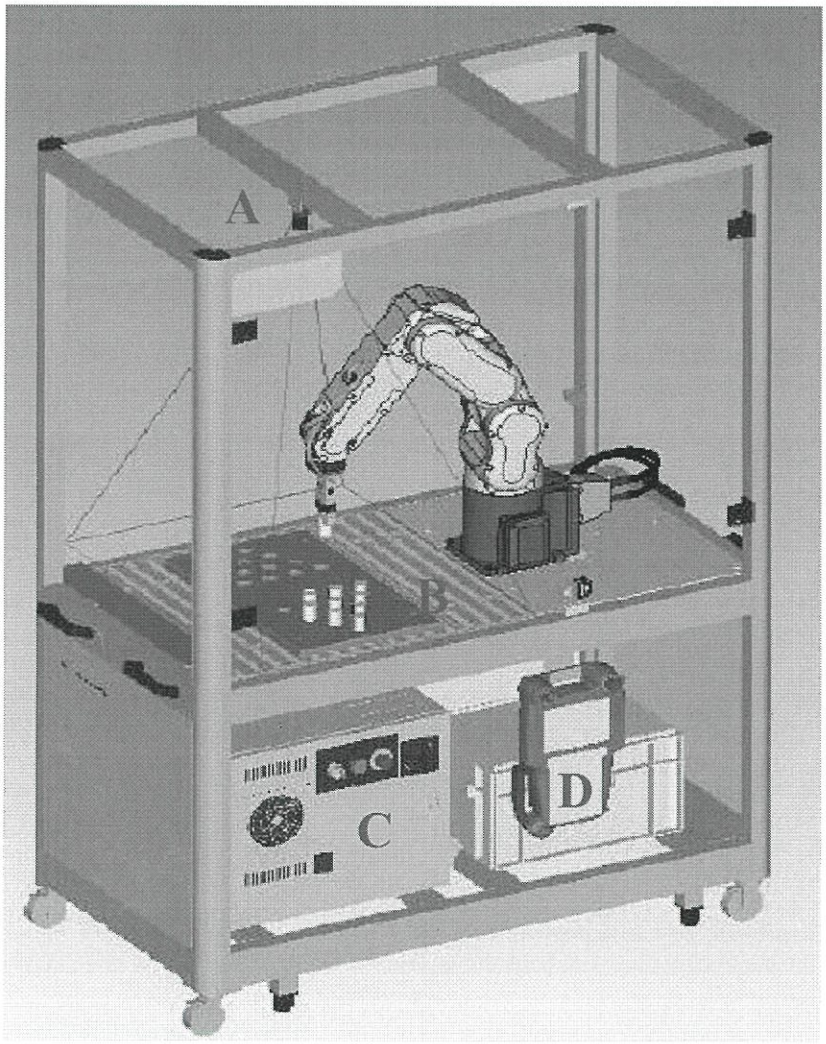

Figure Q3(b)

TERBUKA

FINAL EXAMINATION

SEMESTER / SESSION : SEM II 2021/2022
COURSE NAME: INDUSTRIAL AUTOMATION SYSTEM

PROGRAMME CODE : BEJ
COURSE CODE : BEJ 34103

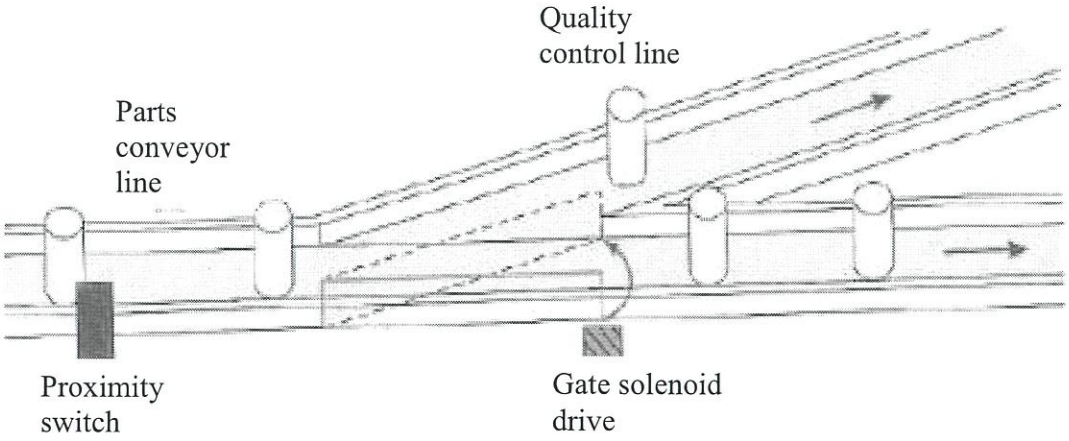

Figure Q4(b)

TERBUKA

FINAL EXAMINATION

SEMESTER / SESSION : SEM II 2021/2022 PROGRAMME CODE : BEJ
COURSE NAME: INDUSTRIAL AUTOMATION SYSTEM COURSE CODE : BEJ 34103

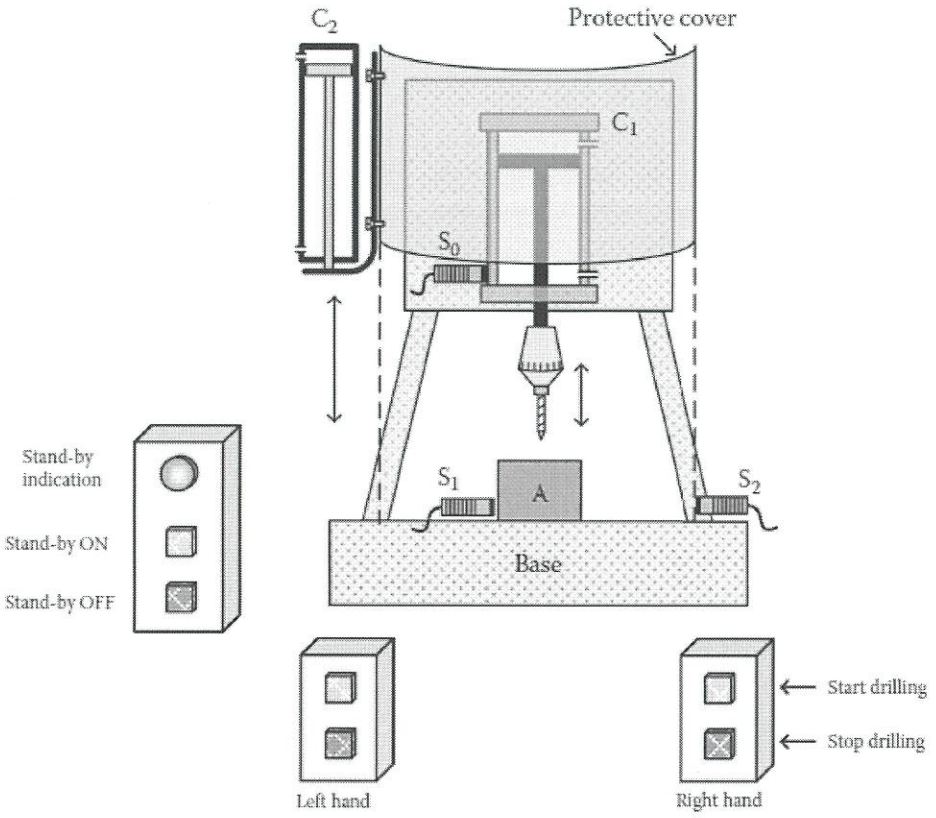

Figure Q5

TERBUKA