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Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER II
SESSION 2022/2023**

- COURSE NAME : MANUFACTURING CONTROL TECHNOLOGY
- COURSE CODE : BDD 40803
- PROGRAMME CODE : BDD
- EXAMINATION DATE : JULY / AUGUST 2023
- DURATION : 3 HOURS
- INSTRUCTION
1. ANSWER **ALL** QUESTIONS
 2. THIS FINAL EXAMINATION IS A CONDUCTED VIA **CLOSED BOOK.**
 3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE FINAL EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

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- Q1 (a) Group technology (GT) is a manufacturing philosophy that identifies and exploits the underlying sameness of parts and manufacturing processes. In batch-type manufacturing for multi-products and small-lot-sized production, conventionally each part is treated as unique from design through manufacture. The biggest single obstacle in changing over GT from a conventional production shop is the problem of grouping the parts into families. Describe two general methods for solving this problem and sketch one example of organized part families.
- (4 marks)
- (b) Flexible Manufacturing Systems (FMS) have an efficient layout arrangement and material flow path design are important due to the large percentage of product cost that is related to material handling. FMS layout configuration handling systems can be classified into five categories. Compare four types of layout configurations of FMS with the aid of sketching.
- (8 marks)
- (c) Rank Order Clustering (ROC) is an algorithm used in cellular manufacturing to group parts based on their similarity. It is a type of clustering algorithm that can be used to group parts into 'families' or 'cells' based on their similarity. The following table lists the weekly quantities and routings of ten parts that are being considered for cellular manufacturing in a machine shop according to **Table Q1(c)**. Parts are identified by letters and machines are identified numerically. For the data given, evaluate the part-machine incidence matrix, and the rank order clustering technique to the part-machine incidence matrix to identify logical part families and machine groups.
- (8 marks)
- Q2 (a) Sensors can be classified in various ways for collecting data from the manufacturing process for feedback control. A sensor is a transducer which is a device that converts a physical variable of one form into another form that is more useful for the given application. Describe the differences between proximity and photoelectric sensor with the aid of sketching and the type of application on each type of sensor.
- (4 marks)
- (b) Nearly all industrial robots have mechanical joints that can be classified into one of five types: two types that provide translational motion and three types that provide rotary motion. Define with aid of sketch two from five joint types used in robotic arm and wrist.
- (4 marks)

- (c) A 6-axis robot is required to perform the pick and place operation to the designated position for moving part from P2 to P3 and will be welded with the plate at the welding station by a welder robot according to **Figure Q2(c)**. Initial robot program (1) needs to move with joint interpolation to P1. The speed movement needs to be set half to maximum speed when moving (2) and wait for 1 second for the completion of arrival to the target position before closing hand (4) in linear interpolation (3 to 4). Robot needs to wait 0.5 seconds and after that set movement in linear to maximum speed during lift up workpiece (5) and retracted workpiece to 40mm hand direction in half speed (6 and 7) at P3 with performing positioning delay in 0.1 seconds (7) before lift up to P3 (8). The Welder robot will start to weld according to the welding profile when the signal bit 17 turns ON. Evaluate with the aid of textual robot programming language to accomplish this movement.
- (12 marks)

- Q3** (a) A latching switch is a switch that maintains its state after being activated. A push-to-make, push-to-break switch would therefore be a latching switch – each time you actuate it, whichever state the switch is left in will persist until the switch is actuated again. Discuss the two types of latching techniques in PLC programming with the aid of a ladder diagram.
- (4 marks)
- (b) **Figure Q3(b)** shows a conveyor setup for the separation of similar objects into two parallel transportation lines, based on the simple alternative placement of objects through the moving part of the conveyor. Cylinder A pushes objects on the movable part of the conveyor, the placement of which is altered by Cylinder B. When the sensor S1 or S2 detects the passing of an object, then the change of the movable part placement can be performed according to the position-step diagram. The operation of the conveyor system starts with an instant START signal from a button. Similarly, the operation stops with an instant STOP signal from a button but only if the procedure is in the pushing phase (cylinder A in the extension stage). After selecting the required electro-pneumatic equipment (cylinders kind, directional valves, sensors, etc.), evaluate the connection statuses of the electro-pneumatic diagram and subsequently, support your answer with the required PLC ladder program.
- (16 marks)
- Q4** (a) Material handling equipment (MHE) plays an important role in manufacturing and logistics. Almost every item of physical commerce has been transported on a conveyor or lift truck or another type of material handling equipment in manufacturing plants, warehouses, and retail stores. Describe the four categories of MHE equipment including examples from each category.
- (6 marks)

- (b) Barcodes require the scanner to have a direct line-of-sight with the code where are Radio Frequency Identification (RFID) is a near-field technology, which allows the scanner to read the tags within a range and without a direct line-of-sight. Provide six criteria to compare RFID and barcode technologies. Provide an application example to support your choice of RF identification tag.

(8 marks)

- (c) In light of the ongoing COVID-19 epidemic, automated identification and data capture (AIDC) technology is currently being widely used in hospital settings. By using this technology to track the hand-washing supplies used by healthcare personnel, companies in the AIDC market are broadening their sources of income in the healthcare industry. As an engineer, evaluate and thoroughly assess three AIDC technologies for keeping track of the manufacturing sectors' health.

(6 marks)

- Q5** (a) Big Data is a collection of data that is huge in volume, yet growing exponentially with time. It is a data with so large size and complexity that none of traditional data management tools can store it or process it efficiently. In large companies, this data collection is continuously growing with time. Discuss four characteristics of big data with the example of applications.

(6 marks)

- (b) Industry 4.0 describes a future state of industry characterized by thorough digitization of economic and production flows. It requires horizontal integration at every step in the production process, in interaction with machines. In the globally interconnected world of Industry 4.0, machines also interact with one another. Interpret the definition and examples of the concepts that define the future vision of IR4.0 below;

- (i) Augmented Reality
- (ii) Cybersecurity
- (iii) Additive Manufacturing

(6 marks)

- (c) The Internet of Things (IoT) describes the network of physical objects "things" that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet. These devices range from ordinary household objects to sophisticated industrial tools.. Write the four major IoT components and sketch the example of an application on IoT components integration to represent the IR 4.0 concept.

(8 marks)

- END OF QUESTION -

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Part	Weekly quantity	Machine routing	Part	Weekly quantity	Machine routing
A	50	3 → 2 → 7	F	60	5 → 1
B	20	6 → 1	G	5	3 → 2 → 4
C	75	6 → 5	H	100	3 → 2 → 4 → 7
D	10	6 → 5 → 1	I	40	2 → 4 → 7
E	12	3 → 2 → 7 → 4	J	15	5 → 6 → 1

Table Q1(c) Weekly quantities and routings of ten parts

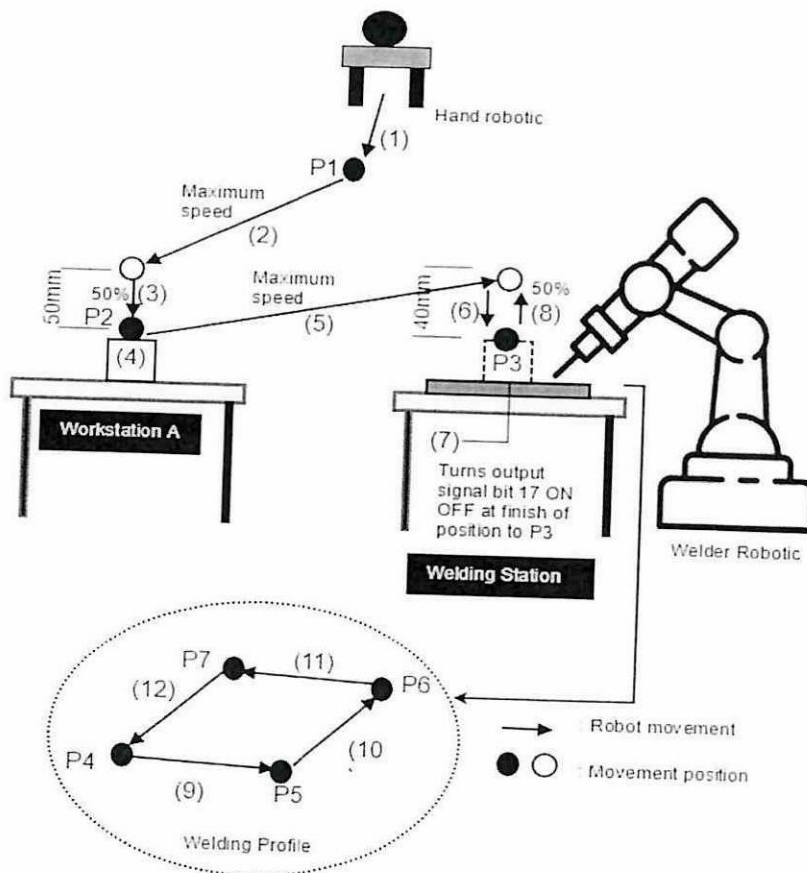


Figure Q2(c) Welding and Pick& Place Robot

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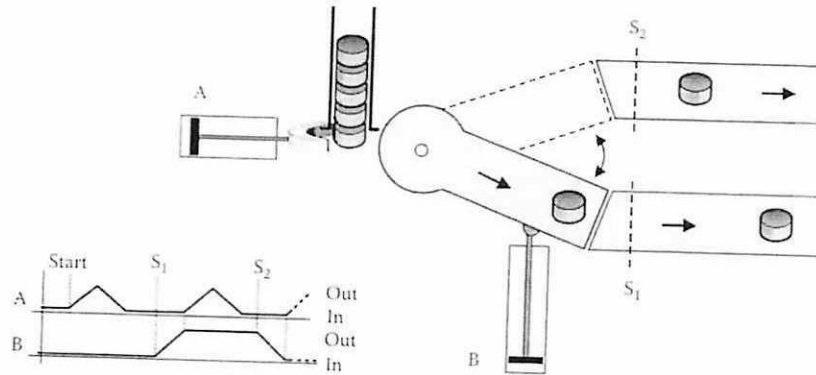


Figure Q3(b) Conveyor for separation objects

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