



UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER II
SESSION 2012/2013**

COURSE NAME : AUTOMATION SYSTEM AND
ROBOTICS

COURSE CODE : DAE32503

PROGRAMME : 3 DAE/ DAL

EXAMINATION DATE : MARCH 2013

DURATION : 2 1/2 HOURS

INSTRUCTIONS : ANSWER **FOUR (4)** QUESTIONS
ONLY

THIS QUESTION PAPER CONSISTS OF NINE (9) PAGES

- Q1** (a) Define the terms of
- (i) Robot
 - (ii) Robotics
- (4 marks)
- (b) Nowadays robots are preferred in industrialization. Discuss three (3) reasons of using robots instead of human to perform a task.
- (6 marks)
- (c) Figure Q1(c) shows an industrial robot.
- (i) Label all the basic components of industrial robot on the figure itself. *(Please attach the answered paper with the answer booklet)*
 - (ii) Describe each component briefly.
- (15 marks)
- Q2** (a) You are working as an Assistant Engineer in a rice manufacturer company. You and your engineer have been assigned to find a robot that could handle palletizing on the plant floor. Then, you come across these robot specification catalogues (see Figure Q2 (a)(i) & Figure Q2(a)(ii)).
- (i) Compare robot **Presto LP 130-01** with robot **OKURA A700III** by explaining each robot type of motion, DOF, payload to body weight ratio, accuracy and reach.
 - (ii) Neglecting the price, choose the most suitable robot to accomplish the task and give two appropriate reasons.
- (17 marks)
- (b) Referring to Figure Q2(b), suggest four (4) safety procedures that should be followed by user to avoid all possible mishaps that might occur during the operation of the cell.
- (8 marks)
- Q3** (a) The SCARA and rectangular robot are types of robot manipulator configuration. Differentiate them according to;
- (i) Axes motion.
 - (ii) Sketch of work envelope for swing view and elevation view.
- (6 marks)

- (b) Figure Q3(b)(i) and Figure Q3(b)(ii) are 3-D view of work envelope of robots. From the figures, identify the following characteristics and compare them in a table form;
- (i) Type of arm geometry.
 - (ii) Sketch the appropriate robot manipulator.
 - (iii) Two advantages of manipulator configuration.
 - (iv) Two disadvantages of manipulator configuration

(14 marks)

- (c) Identify and determine the following industrial robot in Figure Q3(c)(i) and Figure Q3(c)(ii) according to their characteristic as below:

- (i) Arm geometry.
- (ii) Number of degree of freedom (DOF).

(5 marks)

- Q4** (a) The path control is the method of directing the route taken by a robot to travel from one location to another. Briefly explain

- (i) limited sequence path control
- (ii) point-to-point path control

(12 marks)

- (b) Pneumatic is one of the power source to actuate robot manipulator. Summarize the advantages of pneumatic power source in industrial robot.

(4 marks)

- (c) The most commonly used electric drives in robotics are DC servo motor, AC servo motor and Stepper motor. List three (3) features for each electric drive mentioned.

(9 marks)

- Q5** (a) Based on graftset in Figure Q5(a) illustrate a ladder diagram using KEEP instructions.

(4 marks)

- (b) A Separator Conveyor as in the Figure Q5(b), with an up counter must be programmed as part of a batch counting operation to sort parts automatically for quality control. The counter is installed to divert 1 part out of every 10 for quality control or inspection

purpose. The process operates as follows. A Start push button (SB) is used to turn on the conveyor motor. A proximity sensor (S1) will counts the parts as they pass on the conveyor. When a count of 10 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 continue accumulates counts. A reset push button (RB) is provided to reset all the operation.

- (i) Identify the input and output assignment by using CJ1M address.
- (ii) Describe the production process flow by using motion diagram.
- (iii) Illustrate the PLC ladder diagram.

(15 marks)

- (c) Write down the mnemonic code for the ladder diagram shown in Figure Q5(c).

(6 marks)

- Q6** (a) Computer Numerically Controlled (CNC) can be defined as a form of programmable automation in which the process is controlled by number, letter and symbol. Discuss the important of CNC in the industry.

(4 marks)

- (b) Automation manufacturing systems can be classified into three basic types that are Fixed Automation, Programmable Automation and Flexible Automation. Discuss the features of each automation types above according to:

- (i) Definition
- (ii) Configuration operation
- (iii) Production

(10 marks)

- (c) Suggest type of automation for the following products manufacturing and give reasons for the recommendation.

- (i) Palm oil
- (ii) Hard disk
- (iii) Washing machine

(6 marks)

- (d) The concept of automated system can be applied to various levels of factory operation. List accordingly to the five (5) hierarchy level of automation.

(5 marks)

- END OF QUESTION -

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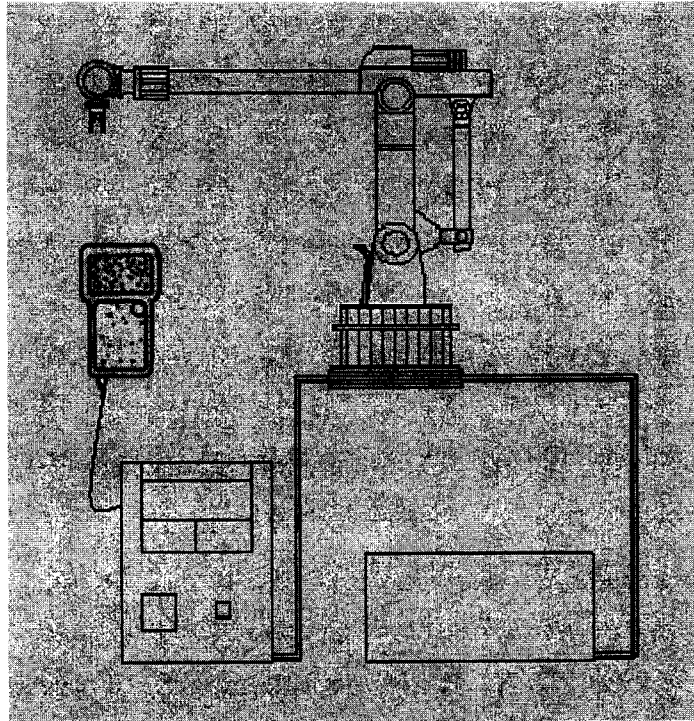


FIGURE Q1(c)

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Robot model [Presto LP130-01] [Presto LP180-01]

Item		Specification	
Robot model		Presto LP130-01	Presto LP180-01
Structure		Articulated	
Degree of freedom		4	
Drive system		AC servo motor	
Max. working range	J1	±3.14rad	
	J2	+0.71~ -1.65rad	
	J3	+0.30 ~ -2.04rad	
	J4	±6.28 rad (±360°)	
Max. speed	J1	2.27 rad/s	2.01 rad/s
	J2	2.01 rad/s	1.75 rad/s
	J3	2.01 rad/s	1.83 rad/s
	J4	6.98 rad/s	6.28 rad/s
Max. payload	Wrist	130 kg	180 kg
	Fore arm	25 kg	
Allowable moment of inertia	J4	50 kgm ²	69 kgm ²
Position repeatability		±0.3 mm	±0.4 mm
Rated air pressure		-101.3kPa ~ 0.69MPa	
Air piping		2-φ12×8 (to the wrist portion)	
Application signals		20 wires (to the wrist portion) 6 wires (to the forearm)	
Ambient temperature		0 ~ 45°C	
Installation type		Floor mounting	
Robot mass		1150kg	

1[rad] = 180/π[°], 1[N·m] = 1/9.8[kgf·m]

FIGURE Q2(a)(i)

OKURA Robot

Robot Type	A1600III	A700III	1600III-W
Motion System	Multi-Articulated, polar coordinate system		
Payload	140 kg (inc. the weight of Gripper Hand)		300 kg (inc. the weight of Gripper Hand)
Freedom of axes	4 axis (R, D, O and T) + 5th Axis as option		
Operation Range	R axis 360 degree	R axis 360 degree	R axis 360 degree
	D axis 2,300mm	D axis 2,300mm	D axis 2,300mm
	O axis 1518mm	O axis 1750mm	O axis 1518mm
	T axis 440 degree	T axis 440 degree	T axis 440 degree
Accuracy	Repeatable stop position accuracy ± 1.0mm		
Robot weight	1,160 kg	1,250 kg	1,175 kg
Pneumatic consumption	180L / Min (ANR)		
Ambient temperature	0-40 Celsius		
Relative humidity	35 -85%		

FIGURE Q2(a)(ii)

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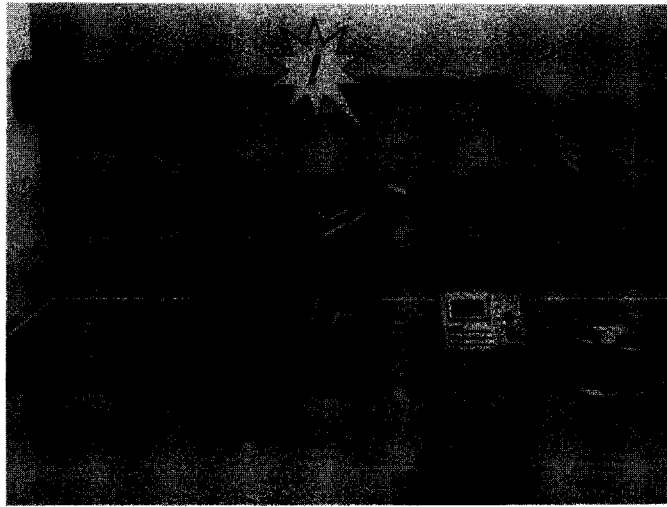


FIGURE Q2(b)

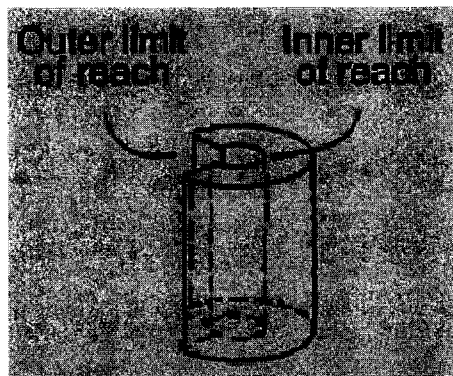


FIGURE Q3(b)(i)

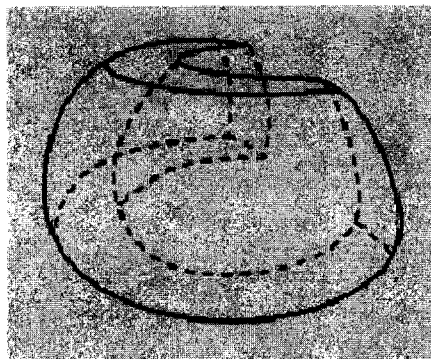


FIGURE Q3(b)(ii)

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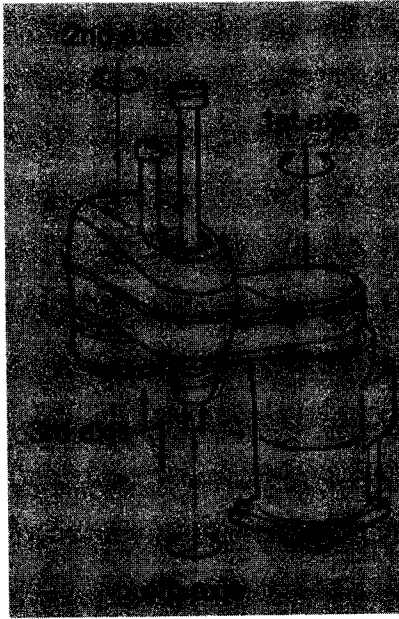


FIGURE Q3(c)(i)

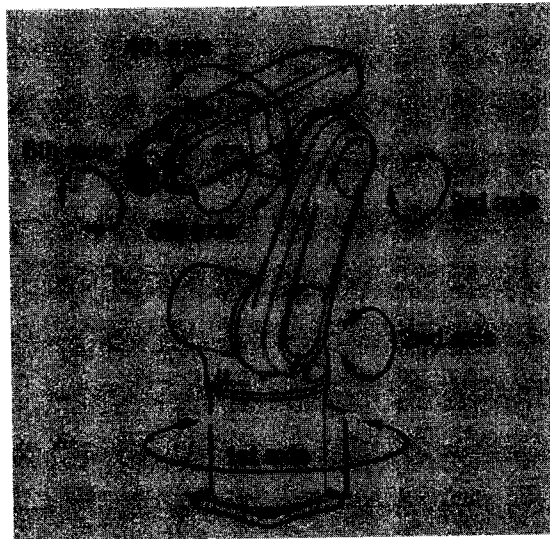


FIGURE Q3(c)(ii)

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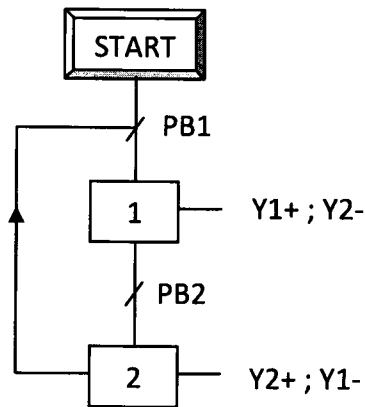


FIGURE Q5(a)

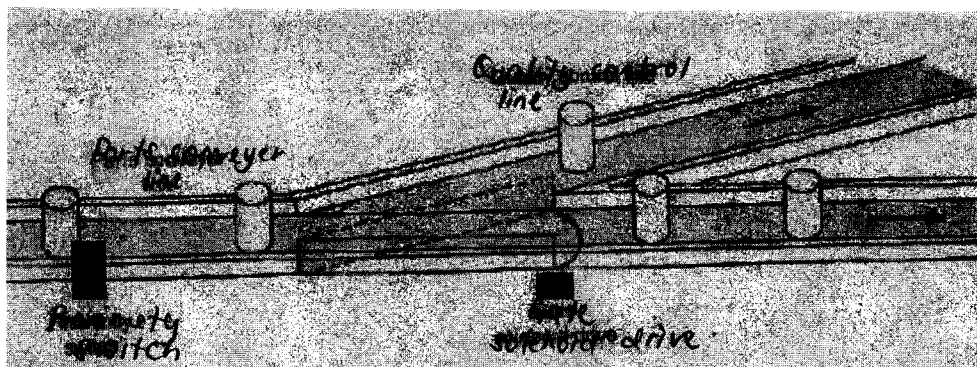


FIGURE Q5(b)

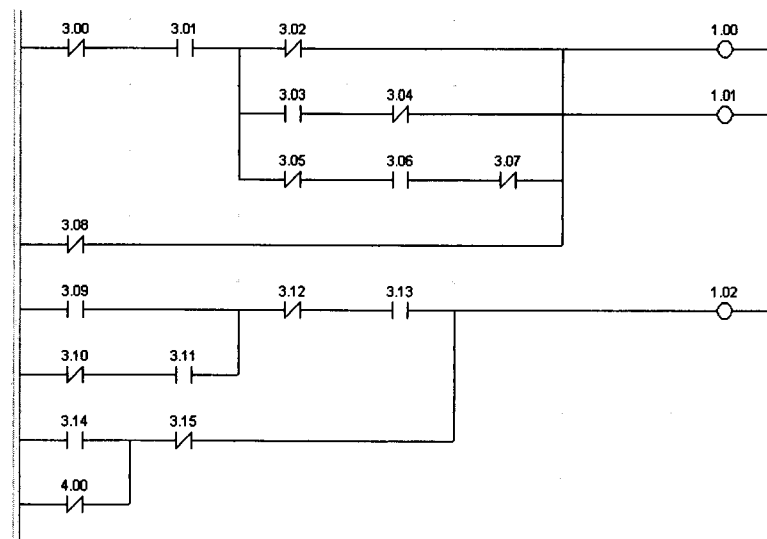


FIGURE Q5(c)