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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER I
SESSION 2014/2015**

COURSE NAME : ROBOTICS AND AUTOMATION
SYSTEMS
COURSE CODE : DAE 32503
PROGRAMME : 3 DAE
EXAMINATION DATE : DECEMBER 2014/ JANUARY 2015
DURATION : 2 HOURS 30 MINUTES
INSTRUCTION : ANSWER **FOUR (4)** QUESTIONS
ONLY

THIS QUESTION PAPER CONSISTS OF FIVE (5) PAGES

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- Q1** (a) Define terms below:
- (i) Industrial robot (defined by ISO 8373)
 - (ii) Automation
- (6 marks)

- (b) *UNIMATE is the first industrial robot made by Unimation in 1959. Ten years later The Unimation robots boosted productivity and allowed more than 90 percent of body welding operations to be automated in General Motor manufacturing plant. – International Federation of Robotics, 2014*

Statement above shows the contribution of robots technology from those years that has lasted till today. State at least **three (3)** contributions of industrial robot technology in 1970s.

(6 marks)

- (c)

“Robots Create Jobs Vs. Robots Create Unemployment”

Discuss the above quote. Choose your opinion and give five points to defend your stand.

(13 marks)

- Q2** (a) **Figure Q2** shows the specification of two model of Staubli robots.
- (i) Compare both model specification in terms of their characteristics.
 - (ii) Suggest an application suit for each model.
- (10 marks)
- (b) Vision systems are being used with robot automation to perform various tasks.
- (i) Identify **five (5)** tasks of vision system.
 - (ii) Briefly explain how these tasks identified in **Q2(b)(i)** functionally in industrial product line.
- (15 marks)

Q3 (a) **Figure Q3(a)(i)** and **Figure Q3(a)(ii)** show diagrams of industrial robots arms. For each figure;

- (i) name type of robot geometry
- (ii) identify degree-of-freedom
- (iii) draw work envelope

(5 marks)

(b) Find the coordinates of point $P = [2, 3, 5]^T$ relative to the reference frame after a rotation of 45 degrees about the z-axis.

(3 marks)

(c) A frame {D} has been moved nine units along x-axis, and five units along z-axis of the reference frame. Find the new location of the frame.

$$\{D\} = \begin{bmatrix} 0.527 & -0.574 & 0.628 & 5 \\ 0.369 & 0.819 & 0.439 & 3 \\ -0.766 & 0 & 0.643 & 8 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

(3 marks)

(d) A frame {W} was rotated about the x-axis 90° , it was then translated about the current z-axis 3 units before being rotated about the z-axis 90° . Finally, it was translated about current y-axis 5 units.

- (i) Write an equation describing the motions,
- (ii) Find the final location of a point $P(1,5,4)$ attached to the frame relative to the reference frame.

(14 marks)

Q4 (a) For all industrial jobs below, suggest most suitable robot geometry for each job. Support your answer with a sketch of work envelope.

- (i) Painting
- (ii) Pick and Place for assembly line
- (iii) Palletizing

(12 marks)

(b) From **Q4(a)**, name type of end-of-tooling that best suit for each job.

(3 marks)

(c) Industrial robot applications can be divided into 4 basic categories.

- (i) List all categories
- (ii) Describe each categories and give example of application.

(10 marks)

- Q5** (a) Automated manufacturing systems can be classified into three standard types. One of them is fixed automation.
- (i) Describe the characteristics of fixed automation
 - (ii) Give an example of manufacturing that apply this automation. (6 marks)
- (b) How a plant would automate is one of the more challenging aspects of the automation implementation process. There are five “how-to” strategies have been suggested. Discuss any **three (3)** of them. (9 marks)
- (c) The goal of any automation is to produce a tangible benefits. Give an example of product manufacturing that can be describe all **seven (7)** benefits of automation. (10 marks)
- Q6** Company Rotee plan to set-up a flexible manufacturing system in their new plant. This company produces a variety of bread for daily consumes.
- (a) Identify the capabilities of flexibilities of their manufacturing. (5 marks)
 - (b) Then, they should qualify as being flexible. Explain all tests they should possess as the manufacturing system would satisfy the criteria. (8 marks)
 - (c) Illustrate the basic FMS components for their new plant with appropriate label. Also explain the details of each component. (12 marks)

- END OF QUESTION-

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Specifications of Stäubli Robot

Model	TX200	TS20
Degrees of freedom	6	4
Nominal load capacity	100 kg	0.5 kg
Maximum load capacity*	130 kg	1 kg
Reach	2194 mm	220 mm
Repeatability	±0.06 mm	±0.01 mm
Protection class (wrist)	IP65 (67)	IP10
Attachment methods	Floor or ceiling	Floor
Stäubli CS8 series controller	CS8C HP	CS8C M

FIGURE Q2

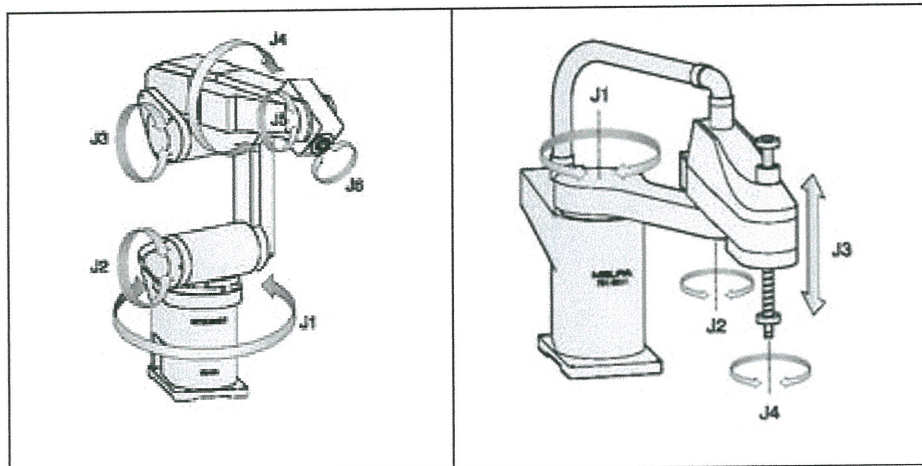


FIGURE Q3(a)(i)

FIGURE Q3(a)(ii)