



UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER I
SESSION 2009/2010**

SUBJECT NAME : AUTOMATION SYSTEM AND ROBOTIC
SUBJECT CODE : DEK 3223
COURSE : 3 DEE/DEX/DET
EXAMINATION DATE : NOVEMBER 2009
DURATION : 2 HOUR 30 MINUTES
INSTRUCTION : ANSWER FIVE QUESTION ONLY

THIS PAPER CONSIST OF 10 PAGES

Q1 (a) Define the terms below:

- (i) Precision.
- (ii) Repeatability.
- (iii) End effectors.

(6 marks)

(b) What is meant by the degrees of freedom of a robot system and how do they compare to the human hand?

(4 marks)

(c) Robots may be moved relative to different coordinate frames. In each type of coordinate frame, the motions will be different. Usually, robot motions are accomplished in three coordinate frames as shown in Figure Q1(c).

- (i) What are the reference frames represented by Frame 1, Frame 2, and Frame 3?
- (ii) Give a brief explanation for each frame in order to differentiate their functions.

(10 marks)

- Q2** (a) Determine the following for the robot as shows in Figure Q2(a).
- (i) Sketch the work envelope.
 - (ii) Sketch the swing view.
 - (iii) Number of Linear Extensional Rotational Twisting (LERT) for this robot.
 - (iv) Number of degree of freedom (DOF).
- (8 marks)
- (b) A jointed arm or revolute coordinated robot performs in an irregularly shaped work envelope and comes in two basic configurations; vertical and horizontal. Compare the differences based on the following characteristics:
- (i) Axes motion.
 - (ii) Sketch the work envelope from swing view.
 - (iii) The ability to reach around obstacle.
- (12 marks)
- Q3** (a) A robot manipulator can make four (4) types of motion in traveling from one point to another in workplace. Describe and give an example of controlled and uncontrolled path.
- (4 marks)
- (b) Robot systems are usually classified as low-technology and high technology groups. Determine the high-technology robots.
- (6 marks)
- (c) Industrial robot can be classified into six (6) categories which are arm geometry, degrees of freedom, power source, types of motion and intelligent level.
- (i) Briefly explain arm geometry classification of industrial robotics based on axes of motion or coordinates.
 - (ii) Briefly explain industrial robotics power source.
- (8 marks)

- Q4** (a) Automated manufacturing systems can be classified into three basic types. Define and discuss the production rates for each automation types below:
- (i) Programmable Automation.
 - (ii) Flexible Automation.
- (4 marks)
- (b) Recommend the type of automations of the following products. You have to explain why you choose such answer. You can use the appropriate Figure to support your explanation.
- (i) Notebook keypad.
 - (ii) Lorry manufacturing (paint shop).
 - (iii) Colour pencil.
- (6 marks)
- (c) The concept of automated system can be applied to various levels of factory operations. Organize five (5) levels of automation hierarchy based on the level of automation.
- (10 marks)

- Q5** (a) Illustrate the basic components of Programmable Logic Controller (PLC) and give an example input and output to be attached into input/output module.

(5 marks)

- (b) This question based on scenario below and refer to Figure Q5(b),

Figure Q5(b) shows the layout of the 2-Axis robot consisting of a horizontal and vertical mechanism which is used to transfer parts from position A to position B. The horizontal and vertical mechanisms are driven by a double acting and single acting solenoid valve respectively which powered by air cylinders for a left/right and up/down movements. The grip and un-grip action is driven by a single acting solenoid valve. Four reed sensors are employed to detect the position of the mechanisms by placing at each end of the two cylinders' travel limits. For basic application, robot are design to perform the following task:

- 1) Operation starts when push button is pressed.
- 2) Vertical cylinder goes down and rests for 3 seconds before grip the part.
- 3) Vertical cylinder goes up before horizontal cylinder start extend.
- 4) Robot places the part at position B and delay for 3 seconds before un-grip the part.
- 5) Then, robot will return automatically to its starting position.
- 6) Robot will rest for 3 second before perform the task continuously until stop button is pressed.

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

(15 marks)

Q6 (a) Explain the definition and the contribution in industry of:

- (i) Computer Aided Design (CAD)
- (ii) Computer Aided Manufacturing (CAM)
- (iii) Computer Integrated Manufacturing (CIM)
- (iv) Distributed Control System (DCS)

(4 marks)

(b) Illustrate the scope of CAD/CAM and CIM.

(6 marks)

(c) A hydraulic or hydrostatic drive system or hydraulic power transmission is a drive or transmission system that uses hydraulic fluid under pressure to drive machinery.

- (i) Name eight (8) basic components of hydraulic system based on Figure Q6(c)
- (ii) Describe function for each basic component based on Q6(c)(i)
- (iii) What is the major disadvantage of the hydraulic system?

(10 marks)

- Q7** (a) Flexibility is an attribute that applies to both manual and automated system. An automated manufacturing system, consider a machine cell consisting of two CNC machine tools are loaded and unloaded by an industrial robot from a parts carousel, perhaps in arrangement depicted in Figure Q7(a) . Periodically a worker must unload completed parts from the carousel and replace them with new parts. The cell operates in a batch mode which the same part style is produced by both machines in lots of several dozen units.
- (i) In your opinion is it a flexible manufacturing cell? Justify the answer given
 - (ii) How to qualify that the manufacturing system are flexible
- (8 marks)
- (b) Flexible Manufacturing Systems (FMS) can be distinguished according to the number of machines in the system. Figure Q7(b) shows number of machine consist of one CNC machining centre combined with a parts storage system for unattended operation. Completed parts are periodically unloaded from the parts storage units, and raw work parts are loaded into it. According to the number of machines, justify the classification of this FMS scheme in Figure Q7(b).
- (4 marks)
- (c) Explain the level of flexibility in FMS.
- (8 marks)

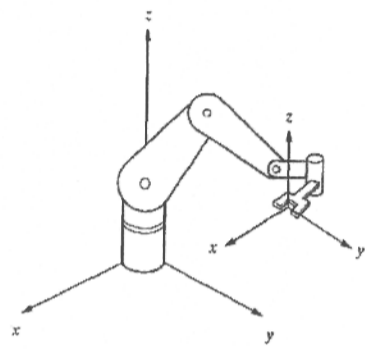
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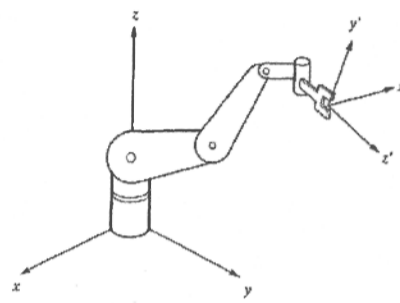
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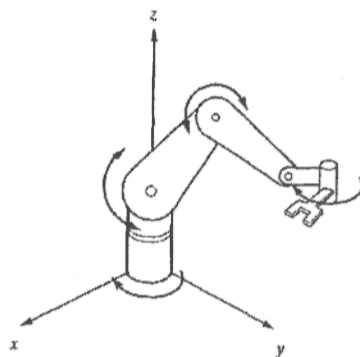
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Frame 1



Frame 2



Frame 3

Figure Q1(c)



Figure Q2(a)

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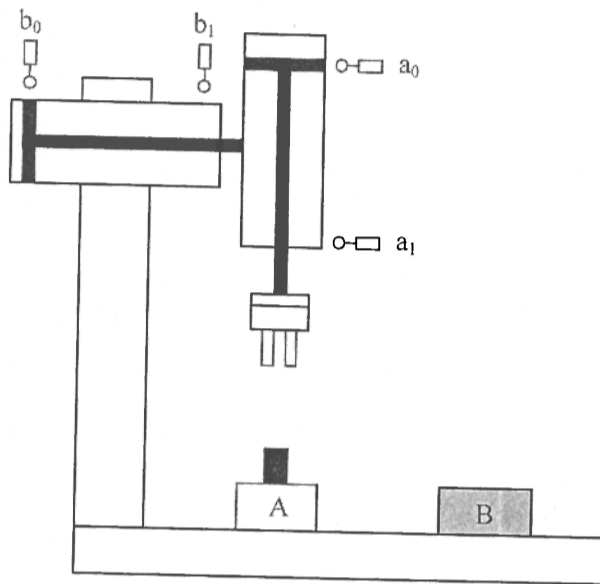


Figure Q5(b)

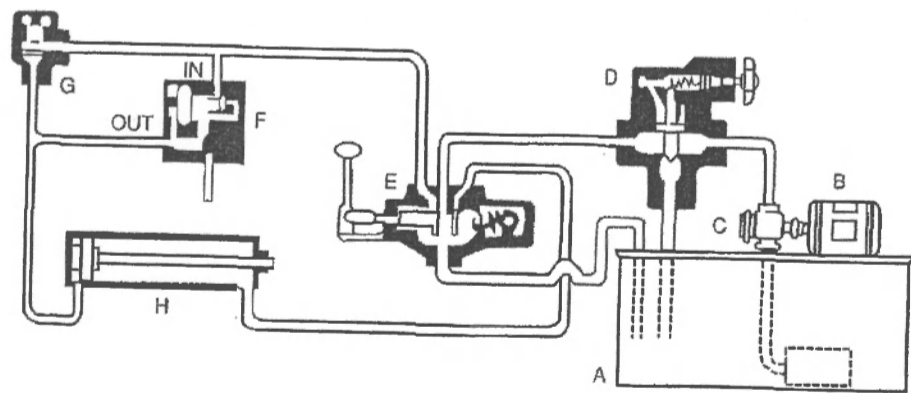


Figure Q6(b)

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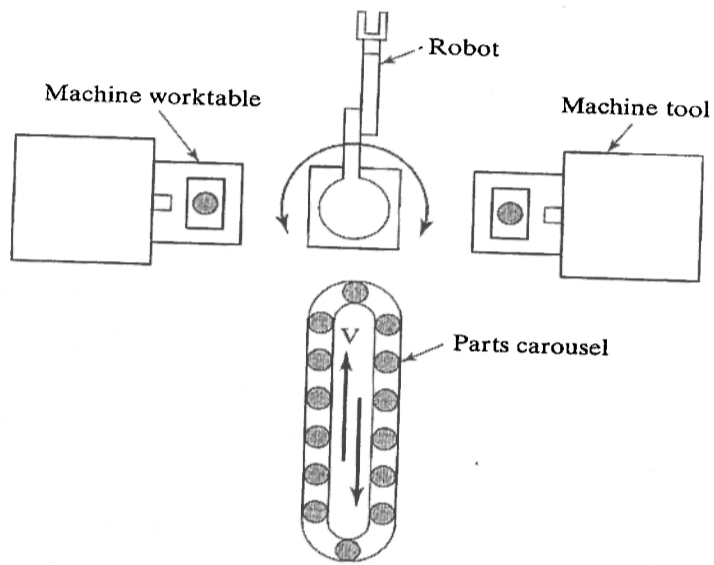


Figure Q7(a)

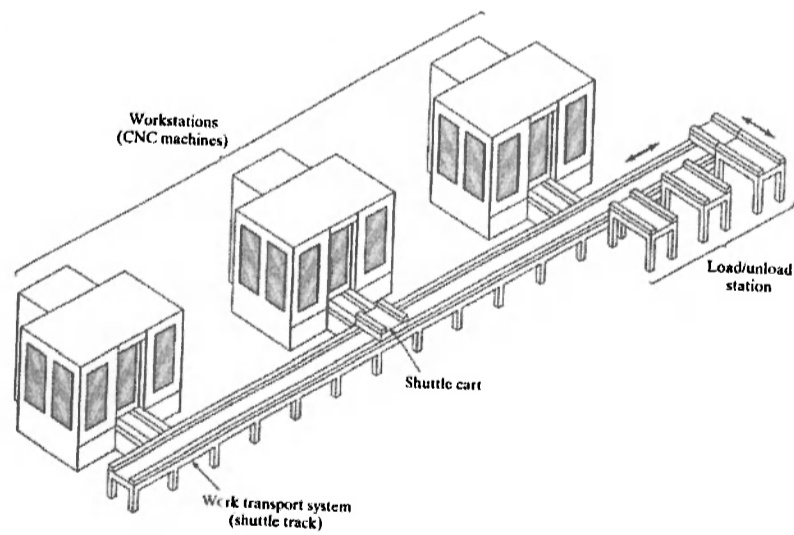


Figure Q7(b)