UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2010/2011

COURSE NAME	:	AUTOMATION SYSTEM AND ROBOTICS
COURSE CODE	:	DEK 3223
PROGRAMME	:	3 DEE/DEX/DET
EXAMINATION DATE	:	APRIL/MAY 2011
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTIONS	:	ANSWER **FIVE (5)** QUESTION ONLY

THIS QUESTION PAPER CONSISTS OF TEN (10) PAGES

Q1 a) Robot characteristic is divided into four categories. Explain what is the meaning of:

i) Payload
ii) Precision

(4 marks)

b) Definition of a robot from Webster is "An automatic device that performs functions normally ascribed to humans or a machine in the form of a human". State three laws that the robots must obey according to Isaac Asimov.

(6 marks)

c) Referring to the Figure Q1(c), propose the safety sensor system that can be taken in work cell design to anticipate all possible mishaps that might occur during the operation of the cell.

(10 marks)

Q2 a) Two (2) of the pneumatic power system components are compressor and regulator. Explain the function of the compressor and regulator respectively.

(2 marks)

b) List out the two advantages and disadvantages for each actuator below:

i) Electric motor
ii) Pneumatic
iii) Hydraulic

(6 marks)

c) Figure Q2(c) shows the basic operation of a hydraulic power system at rest condition when no high pressure is given to pull the plunger.

i) State the six (6) basic components required for hydraulic power system.
ii) Explain briefly the purpose of each component.

(12 marks)

Q3 a) Manipulator is the main body of the robot and it consists of the joints, links, actuators, sensors and controllers. Generally, joints of a manipulator fall into two classes: revolute (rotary) and prismatic (linear).

i) Explain the meaning of degree of freedom.
ii) Draw a simple 3 DOF robot arm to show its base, link and joint.

(4 marks)

b) The robot can be classified according to the type of task, control, configuration and mobility. Discuss the robot classification by task.

(6 marks)

c) A spherical coordinate robot and SCARA coordinate robot performs in an irregularly shaped work envelope and comes in two basic configuration; horizontal and vertical. Compare the differences for both robots based on the following characteristics:

i) Axes motion
ii) Sketch the work envelope
iii) Sketch the for swing view

(10 marks)

Q4 a) Referring to Figure Q4(a) explain two basic components for the Flexible Manufacturing System (FMS).

(4 marks)

b) Carry out the basic components of Computer Numerically Controlled (CNC) System.

(6 marks)

c) Illustrate the levels of CIM System in pyramid shape.

(10 marks)

Q5 a) Human arm can move in three (3) ways. Up and down movement is called PITCH. Movement to the right and left is called YAW. Rotate movement is called ROLL as shown in Figure 5(a). Identify the number of degree of freedom (DOF) for:

i) The shoulder
ii) The elbow
iii) The wrist

(3 marks)

b) Determine the following power shovel in Figure Q5(b)(i) and the folding lamp in Figure Q5(b)(ii) according to its characteristic such as:

i) Arm geometry
ii) Number of Degree of Freedom (DOF)

(4 marks)

c) Robot systems are usually classified as low-technology and high technology groups. Compare the low-technology and high-technology robots.

(6 marks)

d) The point to point robot and continuous path robot was classified as path control robot. Compare the differences for both path control based on the following characteristics:

i) Characteristic
ii) Application
iii) Graph for programmed point

(7 marks)

Q6 a) Computerized system is used to reduce the amount of manual and clerical effort in product design, manufacturing planning and control, and the business functions of the firm. Explain the definition and the contribution in industry of:

i) Computer Aided Design (CAD)
ii) Computer Aided Manufacturing (CAM)
iii) Computer Integrated Manufacturing (CIM)

(3 marks)

b) Automation manufacturing systems can be classified into three basic types. Discuss the features of each automation types below:

i) Programmable automation
ii) Flexible automation

(4 marks)

c) Make a comparison for the fixed and flexible automation in term of uses, maintenance, ability, speed and economical.

(5 marks)

d) The concept of automated system can be applied to various levels of factory operations.

i) Organize five (5) levels of automation hierarchy based on the level of automation.
ii) Briefly explain the plant level

(8 marks)

Q7 a) Modify the ladder logic in Figure Q7(a) using KEEP instruction instead of normal latching.

(4 marks)

b) Figure Q7(b) shows how the 3-Axis Robot move the load from original position to Box B. The process will be repeated fifth times before the process stop. The reset button, RB is used to reset all the operation. There are only 3 sensors available during the processes which are right sensor, forward sensor and backward sensor. The process flow of moving the load is shown below:

Process flow:
PB is pressed – move down – grip the load – move up – move to right – detected by right sensor – move forward – forward sensor - move down – ungrip the load – move up – move backward - backward sensor - return to initial position – process repeated fifth times before stop.

Assumption:
Time for the robot arm to move from up position to down position is 3sec (vice versa)
Time for robot gripper to grip / ungrip the load is 2sec.
Time for robot to move to initial position is 5sec.

It uses 4 different cylinders:

Cylinder A - Single Acting Cylinder (3/2 way valve normally close):
Move down (Y1) and move up robot arm.

Cylinder B - Single Acting Cylinder (3/2 way valve normally close):
Grip (Y2) and ungrip the load.

Cylinder C - Double Acting Cylinder (5/2 way valve normally close):
Move to the right (Y3) and move to the left (Y4) robot arm.

Cylinder D - Single Acting Cylinder (3/2 way valve normally close):
Move forward (Y5) and move backward robot arm.

Base on Figure Q7(b):

i) Identify input output address with suitable address
ii) Construct the process sequence using motion diagram
iii) Illustrate the PLC ladder diagram

(16 marks)

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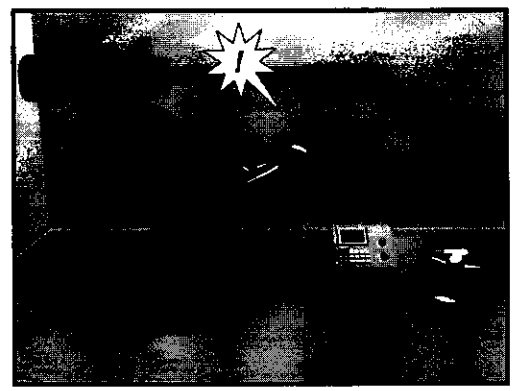

FIGURE Q1(c)

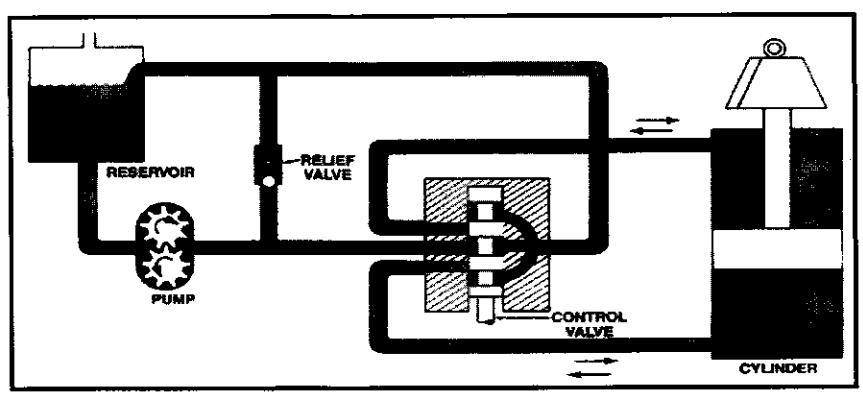

FIGURE Q2(c)

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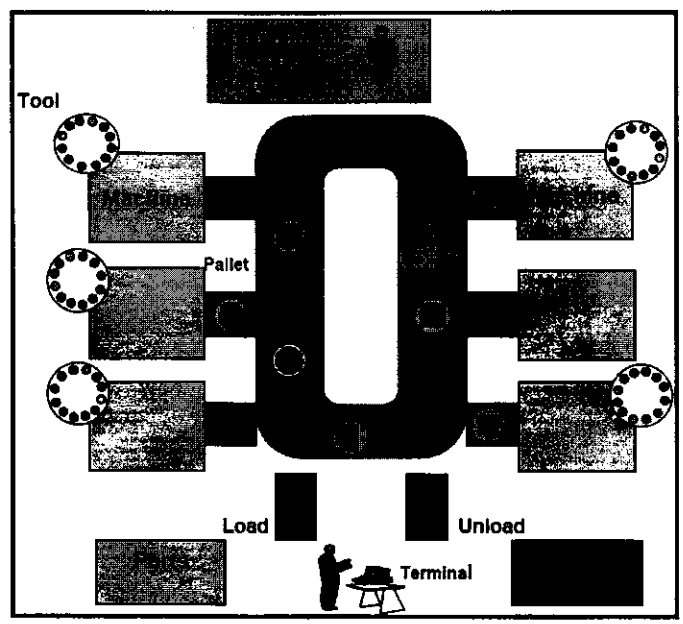

FIGURE Q4(a)

FIGURE Q5(a)

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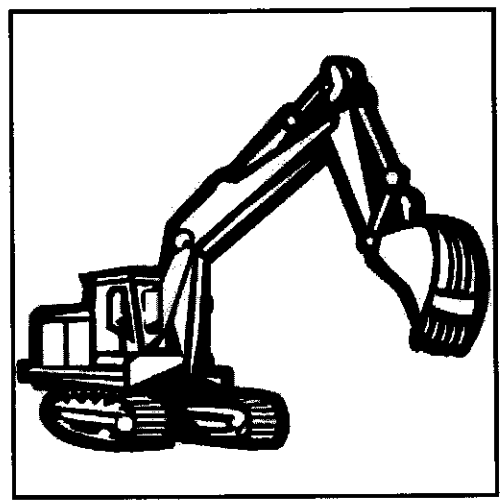

FIGURE Q5(b)(i)

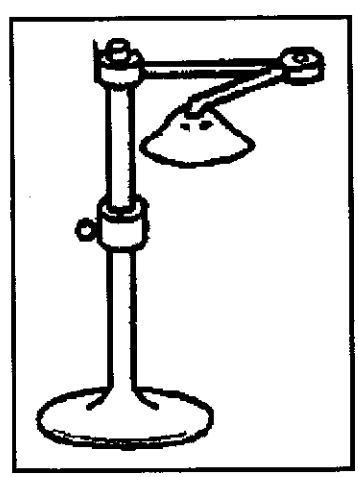

FIGURE Q5(b)(ii)

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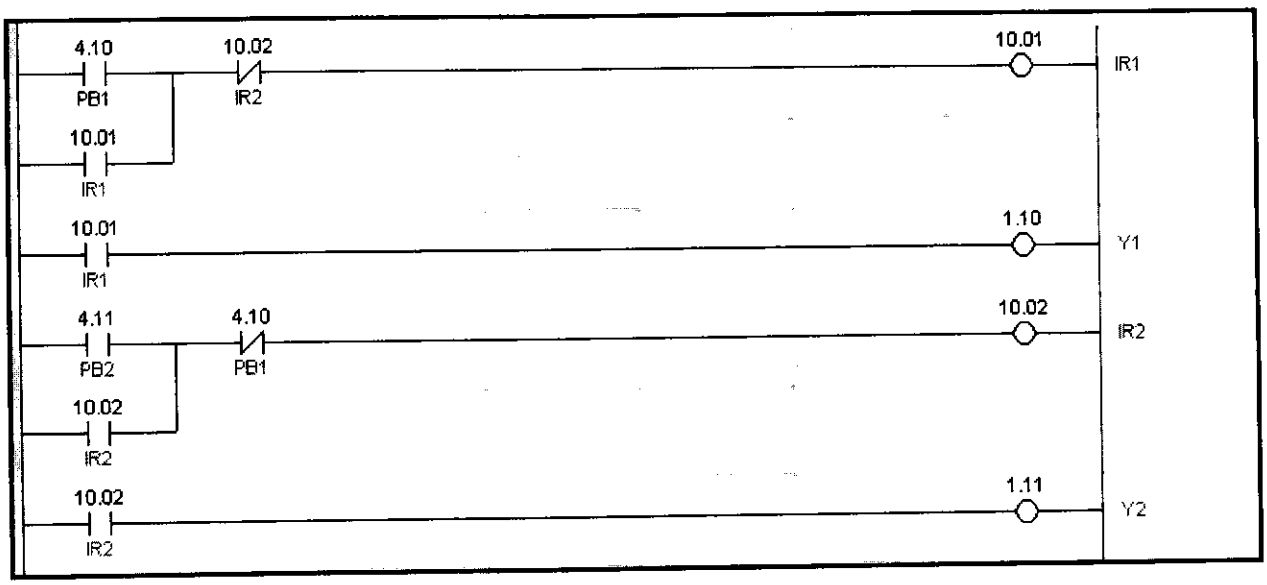

FIGURE Q7(a)

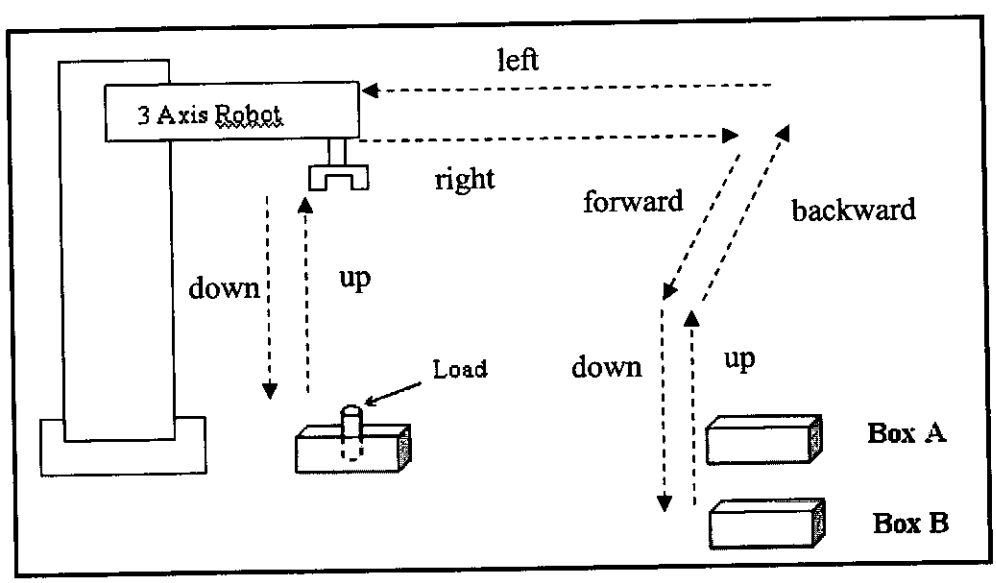

FIGURE Q7(b)