UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2011/2012

COURSE NAME	:	INDUSTRIAL AUTOMATION
COURSE CODE	:	BPC 41203
PROGRAMME	:	3 BPB
EXAMINATION DATE	:	JUNE 2012
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTIONS	:	ANSWER **ALL** QUESTIONS

THIS QUESTIONS PAPER CONSISTS OF **FOUR (4)** PAGES.

Q1 Automation can be defined as the technology by which a process or procedure is accomplished without human assistance

(a) Explain **FOUR (4)** conditions under which automated assembly technology should be considered.

(12 marks)

(b) List **FOUR (4)** system configurations for automated assembly

(4 marks)

(c) Describe **TWO (2)** typical hardware components of a workstation parts delivery system.

(4 marks)

Q2 An industrial robot is a general–purpose, programmable machine possessing certain anthropomorphic characteristics, the most obvious of which is a mechanical arm that is used to perform various industrial tasks.

(a) Differentiate internal and external sensors for industrial robot arm.

(8 marks)

(b) Explain **TWO (2)** characteristics of industrial work situations that tend to promote the substitution of robots for human workers.

(6 marks)

(c) Label the notation scheme for defining manipulator configurations for the robots drawing in **Figure Q2**.

(6 marks)

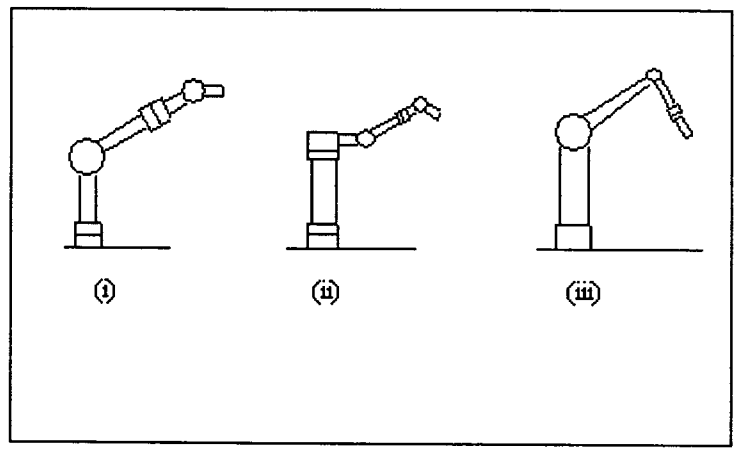

Figure Q2: Robots Drawing

Q3 An automated production line consists of multiple workstations that are automated and linked together by a work handling system that transfers parts from one station to the next. A feeder-selector device at one of the stations of an automated assembly machine has a feed rate of 32 parts per minute and provides a throughput of one part in four. The ideal cycle time of the assembly machine is 10 sec. The low level sensor on the feed track is set at 10 parts, and the high level sensor is set at 20 parts.

(a) Calculate time taken for the supply of parts to be depleted from the high level sensor to the low level sensor once the feeder-selector device is turned off.

(8 marks)

(b) Calculate time taken for the parts to be re-supplied from the low level sensor to the high level sensor, on average, after the feeder-selector device is turned on.

(8 marks)

(c) Calculate the proportion of the operating time of the feeder-selector device when it is

(i) turned on

(ii) turned off

(4 marks)

Q4 Each aisle of a six-aisle Automated Storage/Retrieval System (AS/RS) is to contain 50 storage compartments in the length direction and 8 compartments in the vertical direction. All storage compartments will be the same size to accommodate standard size pallets of dimensions: $x = 36$ inches and $y = 48$ inches. The height of a unit load $z = 30$ inches. Using the allowances $a = 6$ inches, $b = 8$ inches, and $c = 10$ inches;

(a) Calculate number of unit loads can be stored in the AS/RS.

(5 marks)

(b) Calculate the width, length, and height of the AS/RS. The rack structure will be built 20 inches above floor level.

(15 marks)

Q5 A partially automated production line has a mixture of 3 mechanized and 3 manual workstations. There are a total of 6 stations, and the ideal cycle time of 1.0 min, which includes a transfer time of 6 sec. Data on these stations are listed in the table Q5. Cost of the transfer mechanism C_{at} = RM0.10/min, cost to run each automated station C_{as} = RM0.12/min, and labor cost to operate each manual station C_w = RM0.17/min. It has been proposed to substitute an automated station in place of station 5. The cost of this station is estimated at C_{as5} = RM0.25/min and its breakdown rate p_5 = 0.02, but its process time would be only 30 sec, thus reducing the overall cycle time of the line from 1.0 min to 36 sec. Average downtime per breakdown of the current line, as well as for the proposed configuration, is 3.5 min. Assume the line operates without storage buffers, so when an automated station stops, the whole line stops, including the manual stations. Also, in computing costs, neglect material and tooling costs.

Table Q5: Workstation process time data

Station	Type	Process time	p_i
1	Manual	36 sec	0
2	Automatic	15 sec	0.01
3	Automatic	20 sec	0.02
4	Automatic	25 sec	0.01
5	Manual	54 sec	0
6	Manual	33 sec	0

(a) Calculate the following for the current line

(i) Production rate

(4 marks)

(ii) Uptime efficiency

(1 marks)

(iii) Cost per unit

(4 marks)

(b) Calculate the following for the proposed line

(i) Production rate

(4 marks)

(ii) Uptime efficiency

(1 marks)

(iii) Cost per unit

(4 marks)

(c) Conclude the findings from the above exercise.

(2 marks)

END OF QUESTION PAPER