



UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER I
SESSION 2019/2020**

COURSE NAME : APPLICATION OF AUTOMATION SYSTEM
COURSE CODE : BND 43204
PROGRAMME CODE : BND
EXAMINATION DATE : DECEMBER 2019 / JANUARY 2020
DURATION : 3 HOURS
INSTRUCTION : ANSWER ALL QUESTIONS

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THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

- Q1**
- (a) Define industrial robot. (2 marks)
 - (b) Outline **THREE (3)** general characteristics of industrial work situations that tend to promote the substitution of robots for human labor. (3 marks)
 - (c) Explain how automation can help in improving safety of worker and improving the product quality. (4 marks)
 - (d) The concept of automated systems can be applied to various levels of factory operations. An automation factory system collects a large scale of raw potatoes to produce a potato chips snack. As an engineer, you are required to demonstrate all possible components that involved in the system in a flow diagram. (11 marks)
- Q2**
- (a) **Figure Q2(a)** shows jointed-arm robot. Identify which types of industrial robot manipulator joints are used in the jointed-arm robot's base and top of the column. Then, show the direction of the movement. (3 marks)
 - (b) Name the industrial robot shown in **Figure Q2(b)** and suggest **FOUR (4)** tasks the robot can handle. (5 marks)
 - (c) Sketch a robot wrist with labeling of the associated joint movements. (5 marks)
 - (d) Differentiate the powered leadthrough and manual leadthrough programming method. (4 marks)
 - (e) Describe **THREE (3)** limitations of online robot programming. (3 marks)
- Q3**
- (a) Differentiate DC motor with stepper motor in terms of hardware construction, control method and response time. (6 marks)
 - (b) Predict how the motor function in the H-bridge circuit shown in **Figure Q3(b)** will be affected as a result of transistor Q4 fails to open. (2 marks)
 - (c) Illustrate in a block diagram, the procedure for converting an analog signal from the process into digital form. (7 marks)

- (d) Suppose the input signal is 0.6 V. Use the successive approximation method to solve the encoding of the digital value from the input signal for a 10-bit register ADC with a full scale range of 1 V.

(5 marks)

Q4 **Figure Q4** shows a diagram of a mixing tank. To detect level of Material A and Material B, two separate level sensors are used. And to detect low level, one more level sensor is used at the bottom of the tank. To control level of this system, solenoid valve can be used which has two states, either fully open or fully close. The machine works by pushing a start button and the machine will stop when a stop button is pushed. After a start button is pushed, material A and material B are collected in a tank. These materials are mixed using agitator for 20 seconds. Then, the mixed product is drained out through outlet valve.

- (a) Identify the inputs and outputs with suitable address using PLC OMRON CP1E series. The I/O Memory Referencing can be referred to **Appendix A**.

(5 marks)

- (b) Develop a complete ladder diagram to control the operation explained in question **Q4** by using internal relay.

(15 marks)

Q5 (a) Elaborate the difference between image segmentation method and image registration method. Provide an example of technique in image segmentation and image registration methods.

(6 marks)

- (b) You are about to segment a prostate cancer cell as in **Figure Q5(b)**. Construct a Matlab source code that involve the process of reading the image, thresholding, dilating, filling the interior gaps, removing connected objects on boarder and smoothing the object.

(12 marks)

- (c) Suggest an alternative method for displaying the segmented cell image.

(2 marks)

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-END OF QUESTIONS-

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Figure Q2(a)

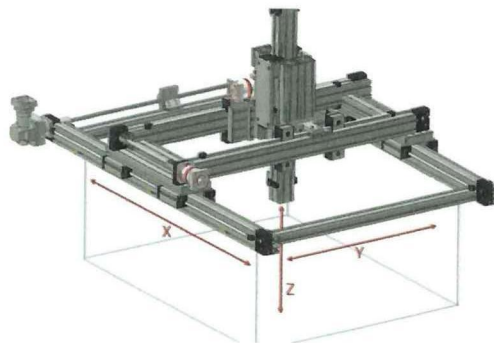


Figure Q2(b)

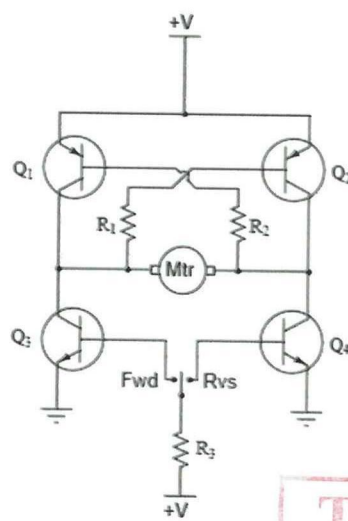


Figure Q3(b)

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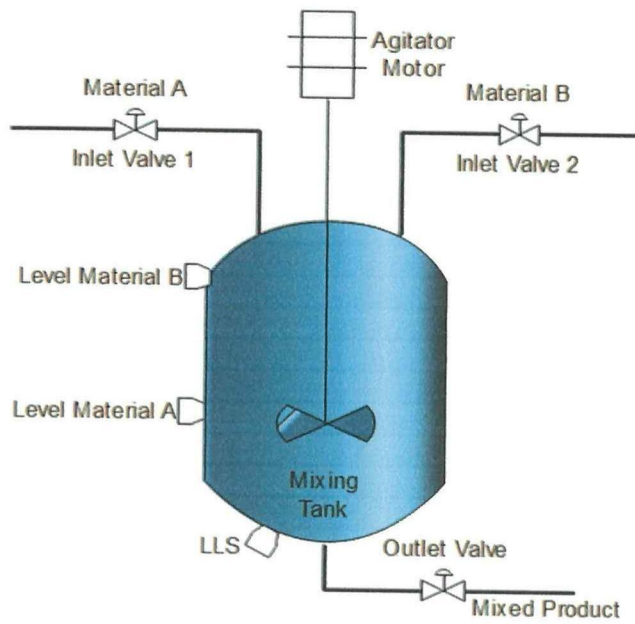


Figure Q4

original image

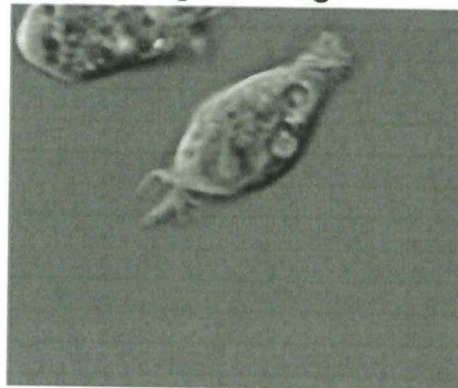


Image courtesy of Alan Partin
Johns Hopkins University

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Figure Q5(b)

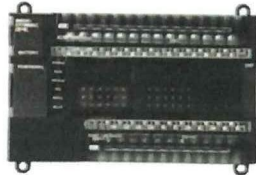
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 AUTOMATION SYSTEM

Appendix A

	CIO 0	CIO 1	CIO 2
10 I/O points	0.00~0.05	-	-
14 I/O points	0.00~0.07	-	-
20 I/O points	0.00~0.11	-	-
30 I/O points	0.00~0.11	1.00~1.05	-
40 I/O points	0.00~0.11	1.00~1.11	-
60 I/O points	0.00~0.11	1.00~1.11	2.00~2.11

Input bits



Output bits

	CIO 100	CIO 101	CIO 102
10 I/O points	100.00~100.03	-	-
14 I/O points	100.00~100.05	-	-
20 I/O points	100.00~100.07	-	-
30 I/O points	100.00~100.07	101.00~101.03	-
40 I/O points	100.00~100.07	101.00~101.07	-
60 I/O points	100.00~100.07	101.00~101.07	102.00~102.07

Area		Size	Range
CIO Area	Input Area	1600 bits (100 words)	CIO 0 to CIO 99
	Output Area	1600 bits (100 words)	CIO 100 to CIO 199
	Built-in Analog Inputs	(NA only)	CIO 200 to CIO 203
	Built-in Analog Outputs	(NA only)	CIO 90 to CIO 91
	Serial PLC Link Area	1440 bits (90 words)	CIO 190
Work Area [W]		1600 bits (100 words)	W0 to W99
Holding Area [H]		800 bits (50 words)	H0 to H49
Data Memory Area [D]	E Type	2048 words	D0 to D2047
	N Type	8192 words	D0 to D8191
Timer [T]	PVs	256 words	T0 to T255
	Completion flag	256 bits	
Counter [C]	PVs	256 words	C0 to C255
	Completion flag	256 bits	
Auxiliary Area [A]	Read-Only (Write-prohibited)	7168 bits (448 words)	A0 to A447
	Read/Write	4896 bits (306 words)	A448 to A753
TR Area [TR]		16 bits	TR0 to TR15

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