UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2017/2018

COURSE NAME	:	APPLICATION OF AUTOMATION SYSTEM
COURSE CODE	:	BND 43204
PROGRAMME CODE	:	BND
EXAMINATION DATE	:	JUNE / JULY 2018
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWERS **FIVE (5)** QUESTIONS ONLY

TERBUKA

THIS QUESTION PAPER CONSISTS OF **EIGHT (8)** PAGES

Q1 (a) Automation can be defined as the technology by which a process or procedure is accomplished without human assistance. Identify and discuss **THREE (3)** basic elements in an automation system.

(6 marks)

(b) Consider an automated cell consisting a CNC machine, a parts storage unit and a robot for loading and unloading the parts between the machine and the storage unit. Develop a possible error (deviations and malfunctions) that might be occurred in the following parts.

(i) Part storage unit.
(ii) Load/unload robot.

(4 marks)

(c) The concept of automated systems can be applied to various levels of factory operations. Organize five levels of automation hierarchy based on the levels of automation.

(10 marks)

Q2 (a) Differentiate active and passive sensors in industrial automation application.

(4 marks)

(b) One type of feedback frequently needed by industrial control system is the position of one or more components of the operation being controlled. Sensors are devices used to provide information on the presence or absence of an object. By referring to **Figure Q2(b)**, propose and briefly explain a suitable sensor that can be used in such automated cell.

(4 marks)

(c) Describe the proposed sensor in terms of the following characteristics:

(i) Working principle.

(2 marks)

(ii) Construction.

(4 marks)

(iii) Operation.

(6 marks)

Q3 (a) Briefly explain the 'commutator' in a DC motor.

(4 marks)

(b) A DC servomotor has a torque constant at 0.088 *Nm/A* and a voltage constant at 0.12 *V/(rad/sec)*. The armature resistance is 2.3 ohms. A terminal voltage of 30 *V* is used to operate the motor. Determine:

(i) The starting torque generated by the motor when the voltage is initially applied.

(4 marks)

(ii) The maximum speed at torque equal to zero.

(2 marks)

(iii) The operating point of the motor when it is connected to a load whose torque characteristic is proportional to speed with a constant of proportionality at 0.011 *Nm/(rad/sec)*.

(6 marks)

(iv) Power delivered by the motor at operating point in unit of *Watts*.

(4 marks)

Q4 (a) The first robots reached the world of industry over 60 years ago. Since then, an industrial robot is widely used in various applications such as welding, assembly, packaging and palletizing.

(i) Define an industrial robot.

(2 marks)

(ii) Identify **THREE (3)** qualities that make industrial robots commercially and technologically important.

(6 marks)

(b) **Figure Q4(b)** provides five types of manipulator joints commonly used in industrial robot configuration. Using the notation scheme for defining manipulator configurations, construct a diagram (similar to **Figure Q4(b)**) of the following robots:

(i) TRL

(6 marks)

(ii) TRT:R

(6 marks)

Q5 (a) Differentiate the function AND and AND LD in a ladder logic diagram construction.

(4 marks)

(b) Construct the instruction list (mnemonic code) for the ladder diagram as shown in **Figure Q5(b)**.

(16 marks)

Q6 (a) Identify and illustrate the basic components of Programmable Logic Controller (PLC).

(5 marks)

(b) In the **Figure Q6(b)**, a tank will be filled with two chemicals, mixed, and then drained. When the Start button is pressed, the program will start Pump 1. Pump 1 runs for 10 seconds, filling the tank with the first chemical, then shuts off. The program then starts Pump 2 to fills the tank with second chemical until float switch is triggered then shut off automatically. At the same time, the program starts the mixer motor to mixes these two chemicals for 60 seconds. The program then opens the drain valve and starts Pump 3. Pump 3 shuts off after 15 seconds and the process stops. A manual Stop switch is also available in the system.

(i) Identify the input and output.

(2 marks)

(ii) Describe the process flow by motion diagram.

(3 marks)

(iii) Construct the PLC ladder diagram for the system.

(10 marks)

Q7 (a) Briefly explain the operation of double acting cylinder with 3/2 way directional valve.

(4 marks)

(b) A pneumatic system is operated at a pressure of 1500 kPa. Calculate the diameter of cylinder required to move a load at 10 kN of force.

(4 marks)

(c) A hydraulic cylinder is to be used to move a work parts in a manufacturing operation through a distance of 50 mm in 8 seconds. A force of 25 kN is required to move the work parts. Determine the required working pressure and hydraulic liquid flow rate if a cylinder with a piston diameter as follows:

(i) 75 mm.
(ii) 120 mm.

(12 marks)

- END OF QUESTIONS -

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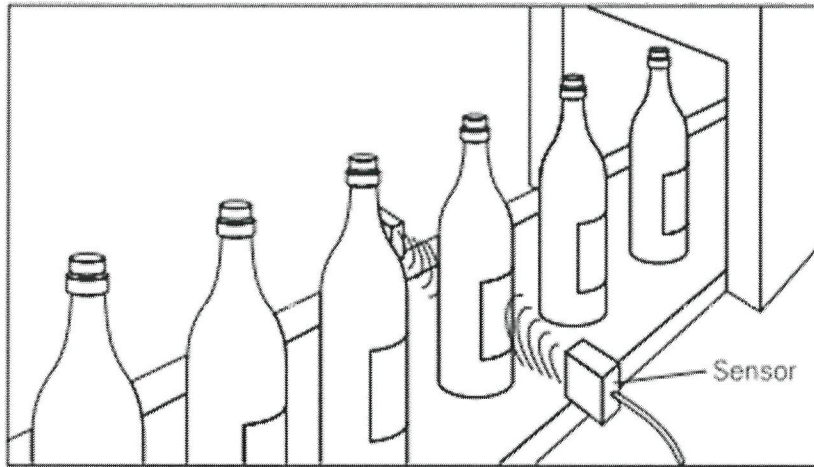
Figure Q2(b)

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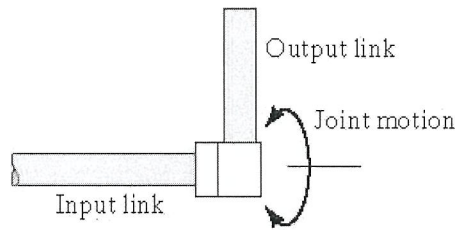   AUTOMATION SYSTEM

(i) Linear joint (type L)

(ii) Orthogonal joint (type O)
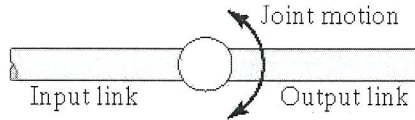
(iii) Rotational joint (type R)
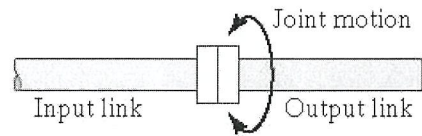
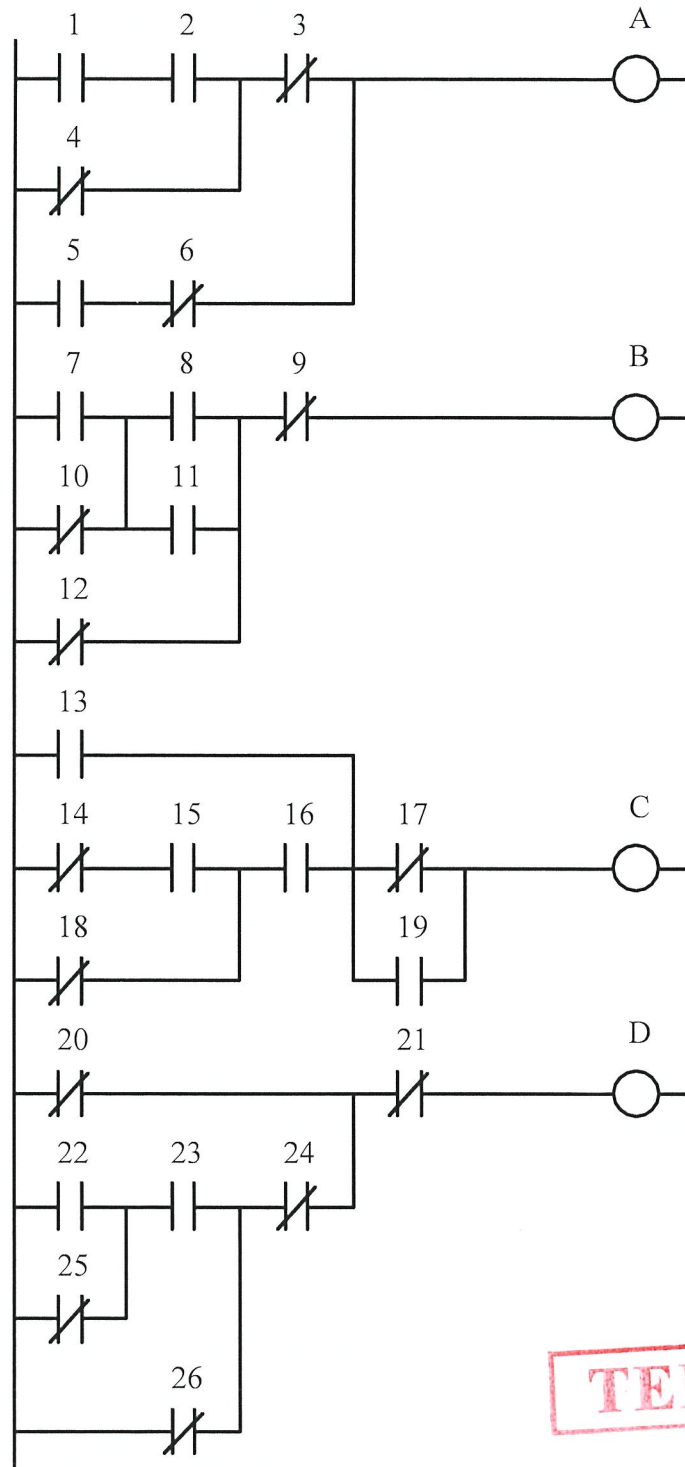(iv) Twisting joint (type T)

(v) Revolving joint (type V)

Figure Q4(b)

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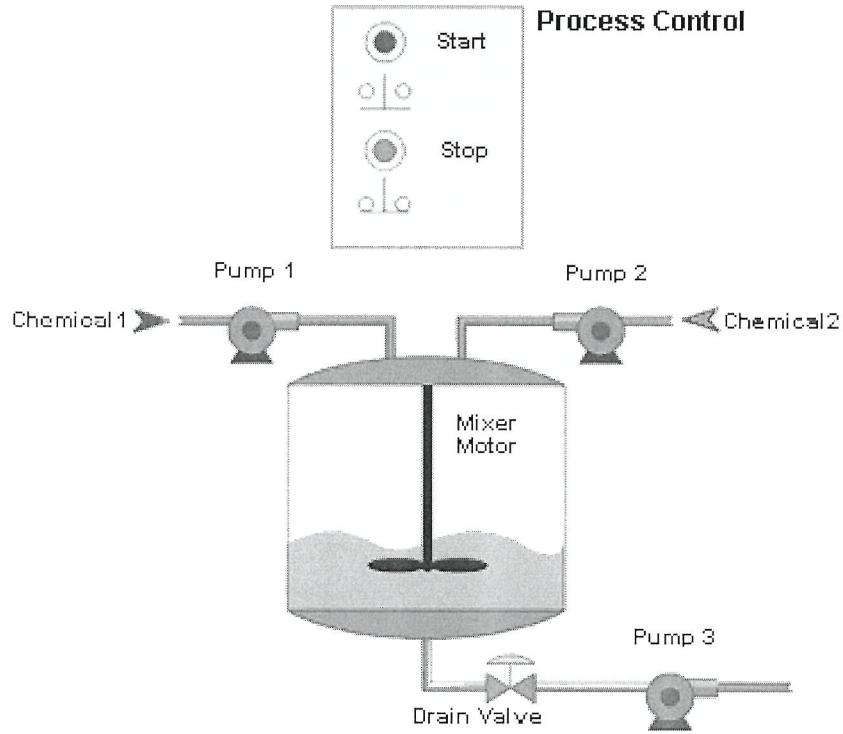COURSE NAME : APPLICATION OF   COURSE CODE : BND 43204
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Figure Q5(b)

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Figure Q6(b)