

University of Ruhuna- Faculty of Technology
Bachelor of Engineering Technology Honours Degree
Level 2 (Semester II) Examination, November/December 2023
Academic year 2021/2022

Course Unit: ENT 2251 – Introduction to Robotics Laboratory

Duration: 2 hours

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- All symbols have their usual meanings.
 - This paper contains **four (04)** questions on **four (04)** pages.
 - Answer **all** the questions.
 - This is a **closed book** examination.
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Q1.

- a) Photoconductive cell can be used as light sensors for automatically activate lights in low light conditions. This application is useful in scenarios such as, street lighting and garden lights.
- i. Briefly explain the working principle of a photoconductive cell.
 - ii. Light Dependent Resistor (LDR) is a photoconductive cell. Plot the relationship between the resistance (R) of the LDR and the level of illumination or light intensity (L).
- (06 marks)
- b) Briefly explain Successive Approximation type analog to digital converter (ADC) using the block diagram.
- (05 marks)
- c) There is a system that includes an 8-bit ADC with a resolution of 40 mV.
- i. Determine the digital output for the given analog voltages:
 - a. 6.005 V
 - b. 6.015 V
 - ii. Compare the digital outputs obtained in part i. a) and i. b) and explain the reason.
- (05 marks)
- d) Calculate the given parameters in digital to analog converters (DAC),
- i. The resolution of a five-bit DAC with a voltage output range of 0 to 15 V
 - ii. The output range of a 6-bit DAC with a resolution of 80 mV
- (09 marks)

Q2.

- a) Draw the symbols of the following components in a pneumatic circuit,
- i. One-way flow control valve
 - ii. Double-acting cylinder

(05 marks)

- b) Imagine a bunch of bottles need to be diverted from the first conveyor belt to the second conveyor belt by using a diverting device as shown in Figure 01. There is a magnetic proximity switch at the end of the belt to identify reaching bottles to that point. When it detects, the packaging is directed to the second conveyor belt. Once switched on, the system is designed to operate continuously and should remain the operation until a stop signal is generated.

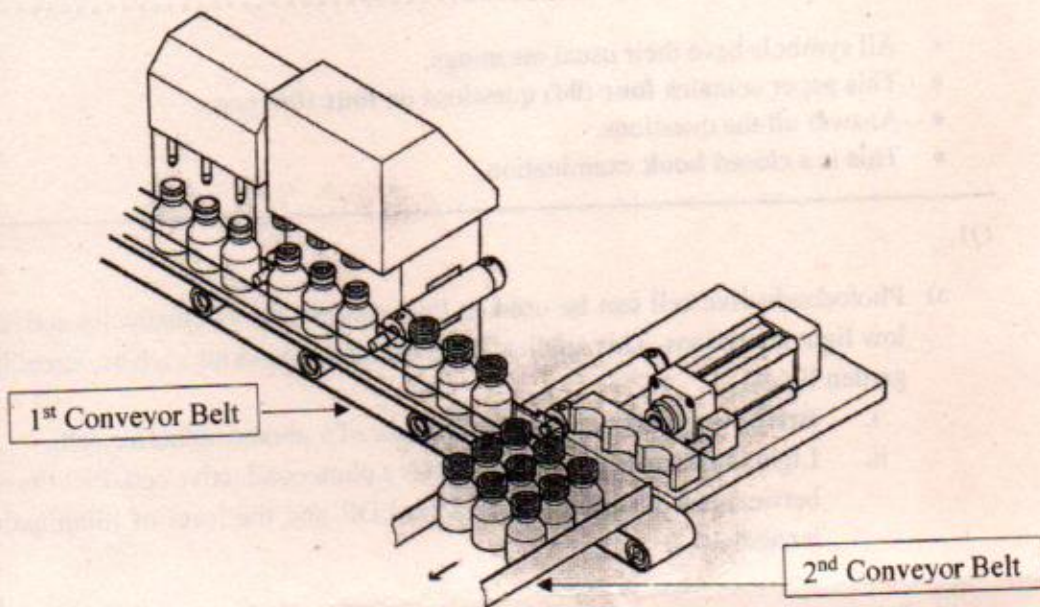


Figure 01: The system of diverting bottles from one conveyor belt to another

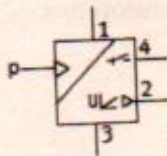
- i. Sketch the following circuit diagrams for complete the above task. (Note: Refer Table 02)
- Pneumatic circuit diagram
 - Electrical circuit diagram

(20 marks)

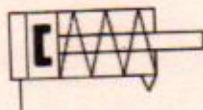
Q3.

- a) Identify the Pneumatic symbols listed below.

i.



ii.



(5 marks)

- b) There is an ink filling system. It is used to fill plastic cans with wall and ceiling paint. After filling inks to the plastic cans, they have to automate the system to fix the lids. For that, lids are going to be pressed onto the plastic cans as shown in Figure 02.

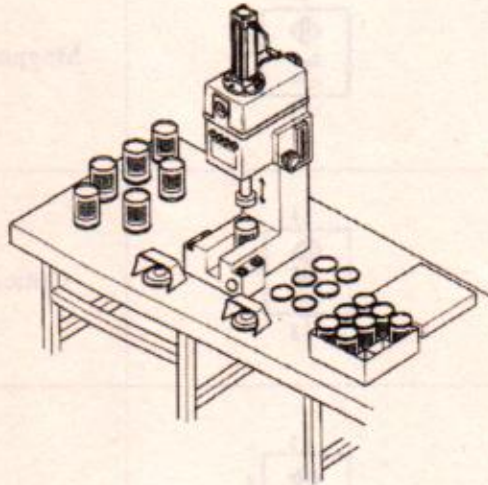


Figure 02: The system fixing lids to plastic cans.

- i. Sketch the below circuit diagrams to automate the system for fixing lids to plastic cans. (Note: Refer Table 02)
- Pneumatic circuit diagram
 - Electrical circuit diagram

(20 marks)

Q4.

- a) Sketch the logic gate symbol, truth table and the ladder diagram to perform the function of given gates,
- OR gate
 - XOR gate

(10 marks)

- b) Sketch the ladder diagrams to obtain the following outputs,
- $X = AB + BC + CA$ using truth table
 - $Y = (\bar{B}C\bar{D}) + (\bar{B}CE) + (\bar{B}C\bar{F})$ without using truth table

(10 marks)

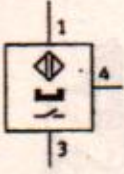
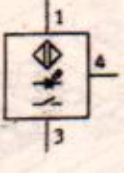
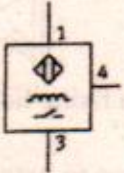
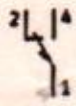
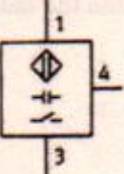
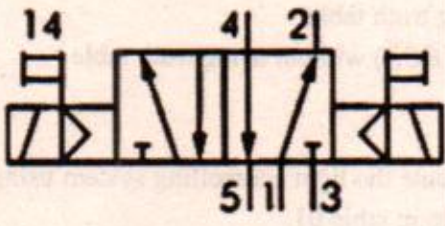
- c) Draw a **ladder diagram** to execute the light controlling system using preset timer. Light controlling method is given in table 01.

Table 01: Light controlling method

| | |
|----------|----------------------|
| LED(ON) | 5 Seconds |
| LED(OFF) | Remain the off state |

(05 marks)

Table 02: Circuit symbols with their designations

| Circuit symbol | Designation |
|---|-----------------------------|
|  | Magnetic proximity switch |
|  | Optical proximity switch |
|  | Inductive proximity switch |
|  | Limit switch |
|  | Capacitive proximity switch |
|  | 5/2 – way solenoid valve |

----- End of the Paper -----