

SULIT



Second Semester Examination
2022/2023 Academic Session

July/August 2023

EEM253 – Mechatronics Design 1

Duration : 1 hour
(Masa : 1 jam)

Please check that this examination paper consists of **FIVE (5)** pages of printed material including appendix before you begin the examination.

Instructions : This paper consists of **TWO (2)** questions. Answer **TWO (2)** questions.

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1. (a) As you are an automation engineer, you are tasked to select a proximity sensor to be used in a process controlled by a programmable logic controller. The programmable logic controller's input module is an 16-input dc input module which has one common. The common for the input module is connected to negative 24V. The sensor is used to detect the presence of aluminium cap for a glass botol. As the process involves the liquid filling, the sensor must be able to function in water splashing environment. The distance between the sensor and the cap is between 2.0 – 5.0mm. The bottles are transported in a conveyor belt. Based on the requirement, choose an appropriate sensor for the task from Table 1.1 Explain your choice of sensor with respect to the selection criteria for a proximity sensor.

Table 1.1 Sensors

Specification	Sensor 1	Sensor 2	Sensor 3	Sensor 4
Description	10 x 16 rectangular inductive prox sensor, DC, plastic	12 x 27 compact rectangular inductive prox, DC, plastic	General-purpose Threaded Capacitive Sensor	General-purpose Threaded Capacitive Sensor
Sensing distance	0.5-6.0 mm	0.5-6.0mm	0.5-6.0mm	3.0-20.0mm
Output	PNP	NPN	NPN/PNP	NPN /PNP
Supply voltage	10-30VDC	10-30VDC	10-30VDC	10-30VDC
Connection type	Axial cable	Axial cable	Axial cable	Axial cable
Protection Degree	IEC-IP67	IEC-IP65	IEC-IP68	IEC-IP67

(20 marks)

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- (b) Explain and discuss what are the considerations made to choose type of programmable logic controller to be used in an automation system.

(30 marks)

- (c) Design the ladder logic for a pumping system. The pump requires a 5-second delay before pumping when the start push button is pushed. When the pump is shut off by another stop switch, it requires a 15-second delay before it can be restarted. Start and stop switches are NO momentary contact push buttons.

(50 marks)

2. A conveyor transportation system which is controlled by an Omron Programmable Logic Controller is shown in Figure 2.1. The object is sliding down on conveyor 1 to a lifting table at the centre. When sensor S3 sensed the presence of the object, the lifting table which is powered by a pneumatic cylinder push the object up and reach at a position which is sensed by sensor S5. Conveyor belt 2 will start and until sensor S6 sense the object. Sensor S4 is used to detect the original position of the lifting table. A normally closed stop switch and a normally open start switch are used to control the start and stop of the system. A start button will start the process in continuous cycle until a stop button is pressed. The object is made from metal.

- a) State all the assumptions that you make for controlling the process.

(10 marks)

- b) Suggest types of sensors for S3, S4, S5 and S6, Give justification for the selection.

(20 marks)

- c) Select type of pneumatic cylinder and directional control valve to be used with justification and draw the pneumatic circuit.

(10 marks)

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d) Design the ladder diagram solution for the above process.

(60 marks)

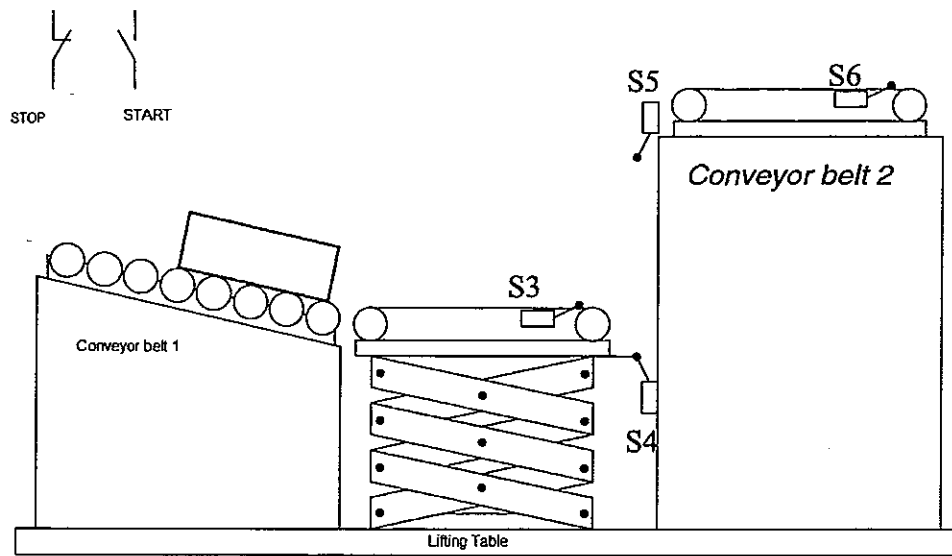


Figure 2.1

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APPENDIX

Course Outcomes (COs) – Programme Outcomes (POs) Mapping

QUESTION	CO	PO
1(a)	1	1
1(b)	1	1
1(c)	1	1
2	2	3