GENERAL CERTIFICATE OF EDUCATION BOARD

Technical and Vocational Education Examination

AUTOMATION
7150

JUNE 2022

ADVANCED LEVEL

Specialty Name and Acronym	**AUTOMOBILE CONSTRUCTION AND MAINTENANCE (AM-LV & AM-HD)**
Subject Title	**AUTOMATION**
Subject Code No.	**7150**
Paper No.	**2**

Duration: 3 Hours

INSTRUCTIONS TO CANDIDATES

This Paper has SIX Parts.

Part I: Answer Any Two Questions.

Part II: Answer Any Two Questions.

Part I: Answer Any Two Questions.

Part IV: Answer Any Two Questions.

Part V: Answer Any Four Questions.

Part VI: Answer Any Two Questions.

All questions in each part carry equal marks.

You are reminded of the necessity for good English and orderly presentation in your answers.

You are advised to read carefully through the question paper, before you begin your answers.

PART I –NUMERATION SYSTEM
(Answer any 2 questions: 7.5 x 2 marks = 15 Marks)

Question 1

I - COMBINATORIAL LOGIC

Let's consider two numbers **Z= 101010111110$_{(2)}$** and **M= CAF$_{(16)}$**

a) Convert M into Binary *(1.5 marks)*
b) Calculate the binary number **Y$_{(2)}$** = M + Z *(2 marks)*
c) Calculate the binary **X$_{(2)}$** = M – Z *(2 marks)*
d) Convert **M** into Octal. *(2 marks)*

Question 2

The automatic door (D) of a motor mechanic workshop is controlled by 4 electric contacts: A, B, C and D. For safety reasons, the keys of the contacts are given to 4 different students' two boys and two girls namely:-

- Alima has the key of contact **A**;
- Shella has the key of contact **B**;
- Randy has the key of contact **C**;
- Joel has the key of contact **D**.

The function mode is as follows:

- The door **(D)** can be opened by either two students of different gender (a boy or a girl), or by all the 4 students. Any other combination will not open the door.
- If two students of the same gender try to open the door, even if one student of the opposite of the opposite gender is associated to them, an Alarm **(L)**will be switched ON.

a) Complete truth table of the door **(D)** *(2 marks)*
b) Extract from the truth table the non-simplified logic equation of the alarm **L***1.* *(3.5 marks)*
c) Plot the karnaugh Map of **L** *(2 marks)*

Question3

Let's consider the true table of the function **F** below

a	b	c	d		F
0	0	0	0		0
0	0	0	1		0
0	0	1	0		0
0	0	1	1		0
0	1	0	0		1
0	1	0	1		1
0	1	1	0		0
0	1	1	1		0
1	0	0	0		1
1	0	0	1		1
1	0	1	0		0
1	0	1	1		0
1	1	0	0		1
1	1	0	1		1
1	1	1	0		0
1	1	1	1		0

S		ab			
		00	01	11	10
cd	00	1	1	1	1
	01	0	1	1	0
	11	0	0	0	0
	10	1	0	0	1

a) Extract from the truth table the logic equation of **F**. *(2 marks)*
b) Establish the KARNAUGH map of **F** from the truth table. *(3 marks)*
c) Deduce from the KARNAUGH map above, the simplified expression of**S**. *(2.5 marks)*

PART II - MICROPROCESSOR AND MICONTROLLER
(Answer any 2 questions: 5 x 2 marks = 10 Marks)

Question 4

Microprocessor and microcontroller structure

a) What is the role of a Micro processing Unit in a microcomputer system? *(2 marks)*
b) Give 3 functions of Memory *(3 marks)*

Question 5

a) Fill the table below with the full meaning of the words found in it. *(5 marks)*

MPU	
EEPROM	
RISC	
RAM	
PROM	
EPROM	

Question6

Application software

a) Name two any types simulation software. *(2.5 marks)*
b) Explainthe meaning of Word processing. *(2.5 marks)*

PART III - CONTROL SYSTEMS
(Answer any 2 questions: 5 x 2 marks = 10 Marks)

Question 7

a) Give the functions of the following below: *(3 marks)*
ii. Controller:
iii. Consign:
iv. Feedback:
b) Give an expression of a second order transfer function and its application. *(2 marks)*

Question 8

Given the following transfer function H(s) = S-3 _____
S^2-3s+2

a) What is the order? *(1 mark)*
b) Give the characteristic equation? *(1 mark)*
c) Give the characteristic polynomial *(1 mark)*
d) State the poles and the zero of the second order transfer *(2 marks)*

Question 9

Control system functions

a) What characterizes a control system? *(2 marks)*
b) Explain the base theorem used to carry out the transfer function? *(2 marks)*
c) Give the name of the software used in control systems? *(1 mark)*

PART IV - INTERGRATED CIRCUIT
(Answer any 2 questions: 5 x 2 marks = 10 Marks)

Question 10

Flip-flops are used to realize electronic counter

a) Name three type of flip-flops use in electronic circuits. *(1.5 marks)*
b) State the formula used to determine modulus of a counter. *(1 mark)*

c) Calculate the number flip-flops use to construct a decade counter. *(2.5 marks)*

Question 11

Using JK flip-flops, Realized a modulus 16 asynchronous counter *(5 marks)*

Question 12

Integrated circuit is manufactured using electronic components

a) State five components found inside an integrated circuit. *(2.5 marks)*

b) Give the full meaning of RISC and CISC *(2.5 marks)*

PART V-SEQUENTIAL LOGIC

(Answer any 4 questions: 10 x 4 marks = 40 Marks)

THEME: **FILLING AND CORKING OF ENGINE OIL GALLONS**

DESCRIPTION

The system consist of a filling device which creates a suction during the retraction of 1A to suck the engine oil from the tank and fill the gallon during extraction of 1A. A corking device to cork the gallon after filling and a conveyor1 to transfer the gallon after filling to the corking post and from the corking post to the store after corking.

Functioning tasks of the filling, corking and stamping of cooking oil gallon system

When gallons are present on the conveyor belt and oil in the tank, and the operator gives an order for the departure of cycle on (SM), the following sequence takes place.

Actions according to the filling and corking unit

- Extraction of oil;
- Filling of oil;
- Transfer of gallon to corking post;
- Transferring of cork to the cork holder tool;
- Return of the corking transfer tool;
- Descending of the corker to pick up the cork from the cork holder;
- Return of the cork holder;
- Corking of the gallons;
- Return of the cork holding device;
- Evacuation of the gallon.
- End of task sequence.

INITIAL CONDITIONS

They are those indicatedon the functional diagram. All cylinders are retractedexcept **1A** which are fully extracted. The gallons are present on the belt of conveyor **1** and the motor are stopped.

WORKING MODES

The system functions cycle by cycle and whenever the gallons are present on the conveyor, the system continues to repeat its cycle.

TECHNOLOGICAL SPECIFICATIONS

ACTUATORS

The system is composed of:

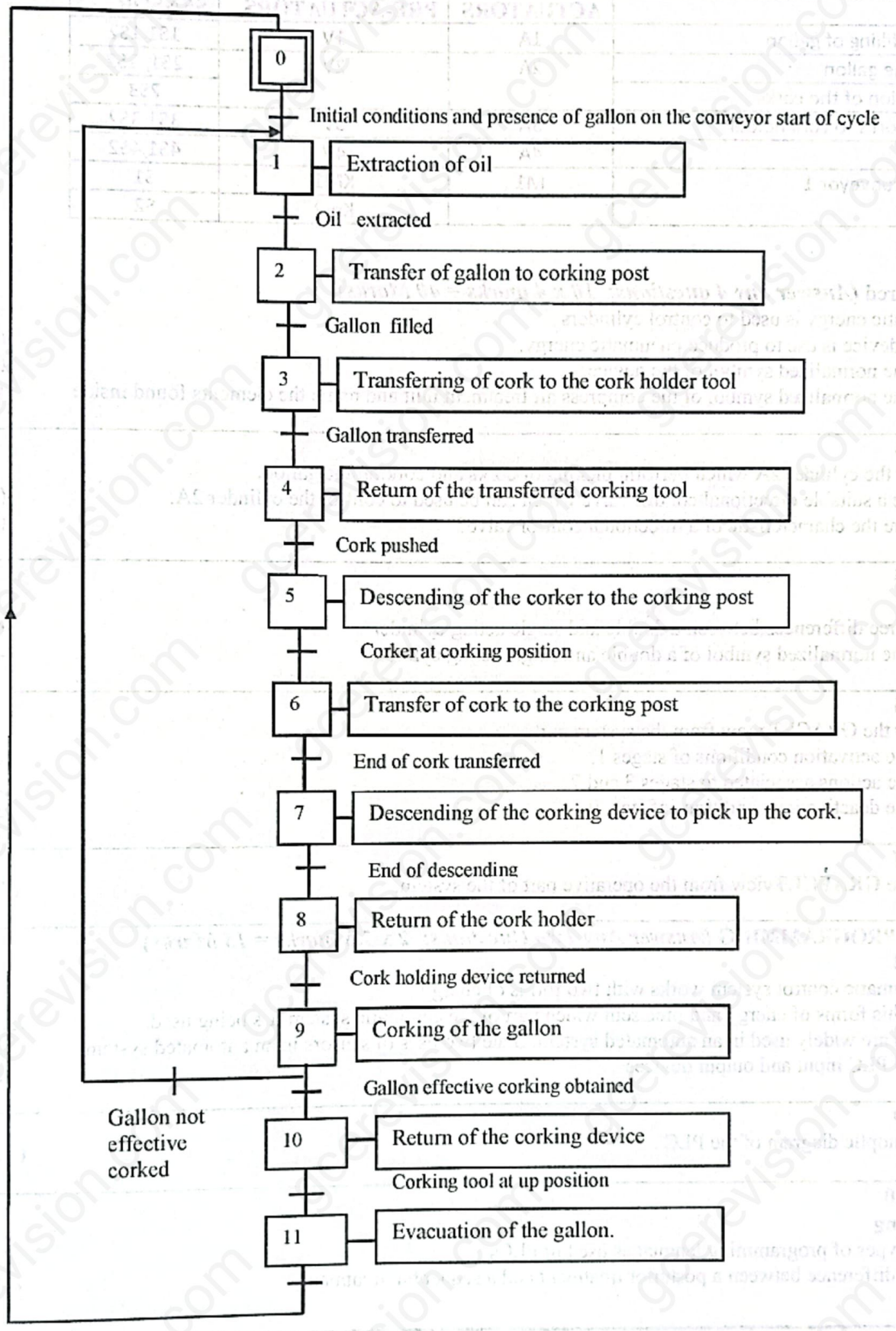
- Four (4) double acting cylinders **1A, 2A, 3A,** and **4A** control by valves (distributors).
- One (1) electrical motors for the rotation of the conveyor.

SENSORS

Sensors **1S1, 1S2, 2S1, 2S2, 3S1, 3S2, 4S1,** and **4S2** are end of course limit switches for the cylinders.

- **SA** selects cycle by cycle or continues mode;
- **Sf** signals effective filling of gallon;
- **Se** signals effective corking of gallon;
- **Sg** signals the presence of gallon at the corking post;
- **SM** is the start of cycle;
- **SP** signals the presence of gallon on the conveyor belt.

GRAFCET VIEW FROM THE SYSTEM PART



DESIGNATION

ACTION	ACTUATORS	PRE-ACTUATORS	SENSOR
Sucking and filling of gallon	1A	1V	1S1,1S2
Corking of the gallon	2A	2V	2S1, 2S2
Pick up position of the corks			2S3
Transfer of corks to cork holder	3A	3V	3S1,3S2
Cork holder	4A	4V	4S1,4S2
Rotation of conveyor 1	M1	KM1	S1
		Km2	S2

Question 13

Work required ***(Answer any 4 questions: 10 x 4 marks = 40 Marks)***

Pneumatic energy is used to control cylinders

a) Which device is use to produce pneumatic energy. *(2 marks)*
b) Draw the normalized symbol of the device. *(2 marks)*
c) Draw the normalized symbol of the compress air treatment unit and name the elements found inside *(6 marks)*

Question 14

Let consider the cylinder 2A which perform picking of corks and corking the gallon.

a) Propose a suitable directional control valve which can be used to control the cylinder 2A. *(7 marks)*
b) What are the characteristic of a directional control valve? *(3 marks)*

Question 15

Actuators

a) State three differences between a double and single acting cylinder *(6 marks)*
b) Draw the normalized symbol of a double and single acting cylinder *(4 marks)*

Question 16

Let consider the GRACET view from the system part.

a) State the activation conditions of stages 1. *(4 marks)*
b) Give the actions associated to stages 3 and 7 *(3 marks)*
c) State the deactivation conditions of state 9 *(3 marks)*

Question 17

Complete the **GRAFCET**view from the operative part of the system. *(10 marks)*

PART VI - PROGRAMMING ***(Answer Any Two Questions: 2 x 7.5 marks = 15 Marks)***

Question 18

Electro pneumatic control system works with two forms of energy.

a) Name this forms of energy and precisein which part of the automatic system it's being used. *(2.5 marks)*
b) Sensors are widely used in an automated system. State two uses of sensors in an automated system *(2 marks)*
c) Name 3 PLC input and output devices *(3 marks)*

Question 19

Draw the synoptic diagram of the PLC *(7.5 marks)*

Question 20

Programming

a) Name 4 types of programming languages used in PLCs *(4 marks)*
b) State the difference between a posterior treatment and a sequential treatment. *(3.5 marks)*

REGISTRATION CENTRE NUMBER	CENTRE NAME	
CANDIDATE'S FULL NAMES		
CANDIDATE IDENTIFICATION NUMBER	SUBJECT CODE **7150**	PAPER NUMBER **2**
FOR OFFICIAL USE ONLY (Candidate Random CODE): ▶		

GENERAL CERTIFICATE OF EDUCATION BOARD

Technical and Vocational Education Examination

Advanced Level

AUTOMATION	SUBJECT CODE **7150**	PAPER NUMBER **2**
Specialty: AUTOMOBILE CONSTRUCTION AND MAINTENANCE: (AM-LV & AM-HD)	EXAMINATION DATE: **JUNE 2022**	

Duration: 3 Hours

ANSWER BOOKLET

INSTRUCTIONS TO CANDIDATES

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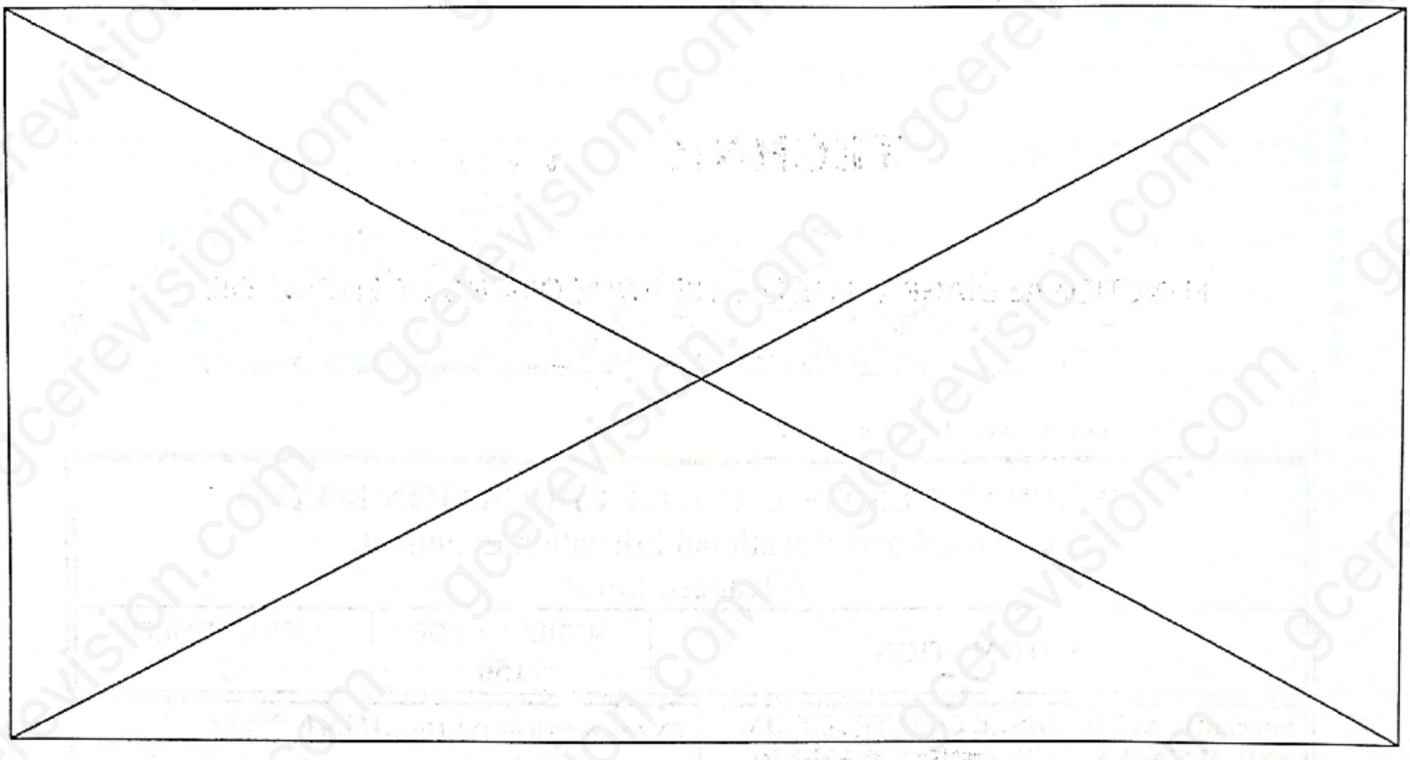
FOR EXAMINERS' USE ONLY	
Marked by:..... *Signature:* .... *Date:*	***SCORE***
Checked by:..... *Signature:* .... *Date:*	

TURN OVER



PART 1 - COMBINATORIAL LOGIC
(Answer any 2 questions: 7.5 x 2 marks = 15 Marks)

Question 1

Let's consider two numbers **Z**= $101010111110_{(2)}$ and M= $CAF_{(16)}$

a) Convert M into Binary----------

1.5marks

b) Calculate the binary number $Y_{(2)} = M + Z$----------

2marks

c) Calculate the binary $X_{(2)} = M - Z$----------

2marks

d) Convert Minto Octal----------

2marks

Question 2

a) Complete truth table of the door **(D)** **(3 marks)**

A	B	C	D		L	D
0	0	0	0		**0**	
0	0	0	1		**0**	
0	0	1	0		**0**	
0	0	1	1		**1**	
0	1	0	0		**0**	
0	1	0	1		**0**	
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1	1	0	0		**0**	
1	1	0	1		**1**	
1	1	1	0		**1**	
1	1	1	1		**0**	

b) Extract from the truth table the non-simplified logic equation of the alarm **L** ----------

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---*1.5marks*

c) Plot the karnaugh Map of **L** *3marks*

CD/AB	00	01	11	10
00				
01				
11				
10				

S		ab			
		00	01	11	10
cd	00	1	1	1	1
	01	0	1	1	0
	11	0	0	0	0
	10	1	0	0	1

Question 3

Let's consider the true table of the function F bellow:

a) From this true table, write down the equation of the function **F**----------

---

---*2 marks*

b) Establish the KARNAUGH map of **F**. *3 marks*

Cd/ab	00	01	11	10
00				
01				
11				
10				

c)Deduce from this KARNAUGH map, the simplified expression of **F**----------
---

---*(2.5marks)*

PART II-MICROPROCESSOR AND MICONTROLLER *(Answer any 2 questions: 5 x 2 marks = 10 Marks)*

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Microprocessor/Microcontroller structure

a) What is the role of a Micro processing Unit in a microcomputer system?----------
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Application software

a) Name the two types of simulation software----------

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b) Explain the meaning of **Word processing?**----------

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PART III-CONTROL SYSTEMS *(Answer any 2 questions: 5 x 2 marks = 10 Marks)*

Question 7

a) Give the functions of the following below: *3marks*

i. Controller----------

ii. Consign----------

iii. Feedback----------

b) Give an expression of a second order transfer function and its application----------

2marks

Question 8

Given the following transfer function $H(s) = \frac{s-3}{S^2-3S+2H}$

a)What is the order?

1mark

b) Give the characteristic equation

1mark

c) Give the characteristic polynomial

1mark

d)State the poles and the zero of the second order transfer

2marks

Question9

Control system functions

a)What characterizes a control system?

2marks

b) Explain is the base theorem used to carry out the transfer function

2marks

c) Give the name of the software used in control systems

1mark

PART IV-INTERGRATED CIRCUIT *(Answer any 2 questions: 5 x 2 marks = 10 Marks)*

Question 10

Flip-flops are used to realize electronic counter.

a) Name three type of flip-flops use in electronic circuits----------

1.5marks

b) State the formula used to determine modulus of a counter----------

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Question 11

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Question 12

Integrated circuit is manufactured using electronic components

a) State five components found inside an integrated circuit----------

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---**2.5 marks**

b) Give the full meaning of RISC and CISC----------

---.*5marks*

PART V-SEQUENTIAL LOGIC ***(Answer any 4 questions: 10 x 4 marks = 40 Marks)***

Question 13

Work required ***(Answer any 4 questions: 10 x 4 marks = 40 Marks)***

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a) Which device is use to produce pneumatic energy----------

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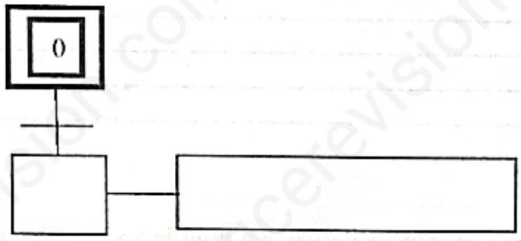

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2marks

c) Name 3 PLC input and output devices----------

3marks

Question 19

Draw the synoptic diagram of the PLC7. **5marks**

Question 20

Programming

a) Name 4 types of programming languages used in PLCs----------

4marks

b) State the difference between a posterior treatment and a sequential treatment----------
---

---*3.5marks*

TECHNICAL FILE

FUNCTIONAL DIAGRAM OF FILLING AND CORKING OF ENGINE OIL