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Faculty of Science and Technology

Department of Electrical Engineering
Subject: PLC
Level: 3rd year

May 11, 2025
Duration: 01 :30H
Speciality: Control

Final Exam

Exercise 1: (05.5 pts)

Answer the following course-related questions:

1. List two sensors, two pre-actuators, and two actuators. **(0.75 pts)**
2. Name three of the most widely used PLC in the industry. **(0.75 pts)**
3. List three advantages and three disadvantages of PLCs. **(1.5 pts)**
4. List four factors that can affect the cycle time of a PLC. **(1.0 pts)**
5. Describe the operating principle of a PLC in five steps, then illustrate it with a diagram. **(1.5 pts)**

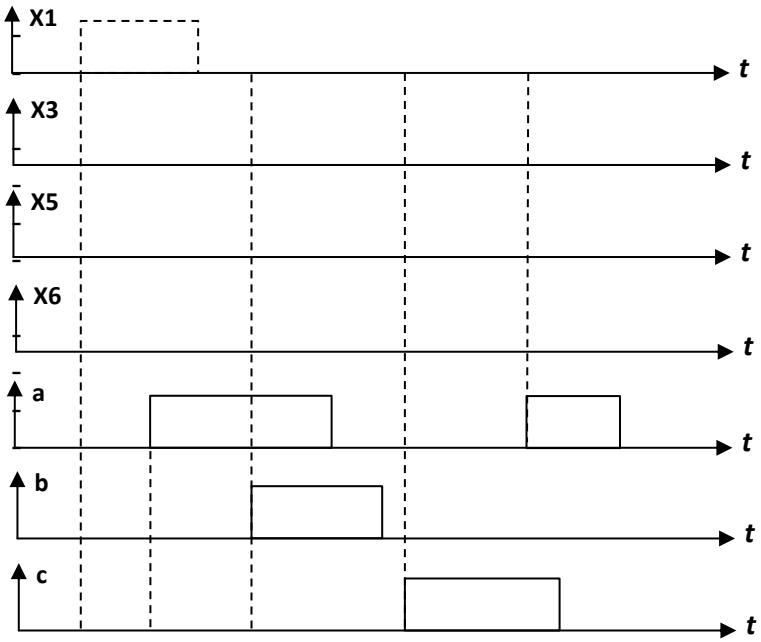
Exercise 2: (02.0 pts)

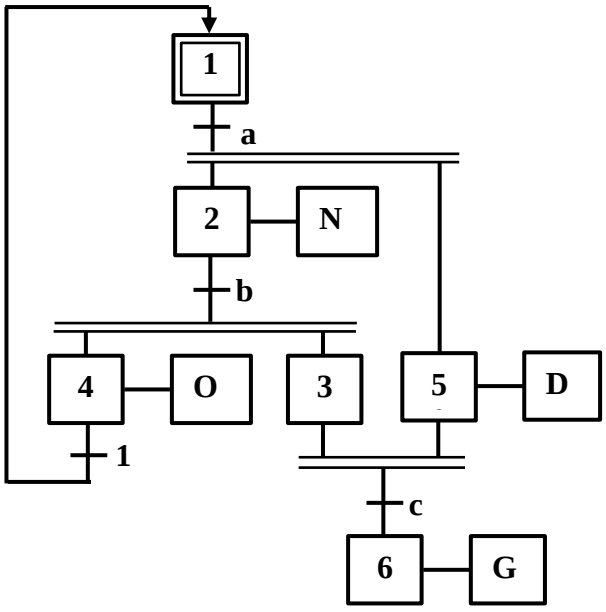
Answer with true or false, and explain your answer if it is false:

a) An LCD display is an actuator. **(0.5 pts)**
b) A speed controller is an actuator. **(0.5 pts)**
c) A pre-actuator is a device that receives commands from the operating part and sends the right energy to the actuator. **(0.5 pts)**
d) Sensors are used to inform the operating part about the state of the system. **(0.5 pts)**

Exercise 3: (03.0 pts)

Complete the timing diagram of **X1**, **X3**, **X5**, and **X6**.





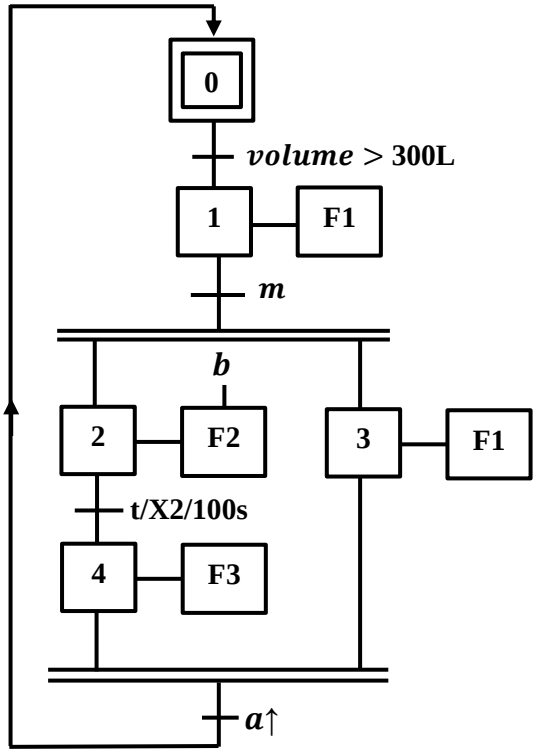
Exercise 04: (05.0 pts)

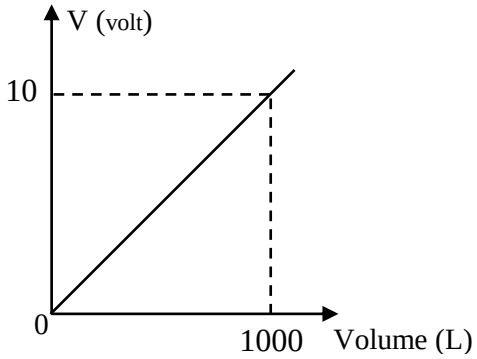
Translate the Grafcet below into an equivalent Ladder Diagram (LD) program for the S7-1200.

Note:

- The analog input at address **IW66** receives a voltage signal ranging from **0** to **10V**, and the water level sensor is connected to this input.
- You can use either the **TON** or **TP** timer. Please specify which one you choose.
- The appendix contains a brief reminder of some key concepts.

Unauthorized documents





Exercise 5: (5.0 pts)

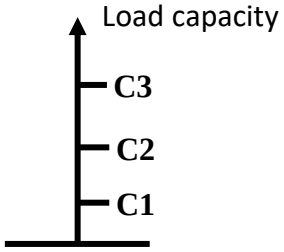
A cable car uses three electric motors: **M1**, **M2**, and **M3**. Each motor is activated based on the load level, in order to move the cabins smoothly.

The load is categorized into three levels: low (**C1**), medium (**C2**), and high (**C3**), to ensure safe system operation.

System operation:

- A start switch is used to turn on the cable car.
- Motor **Mi** is activated when the start switch is on and the load reaches level **Ci**.

- Describe the system using a GRAFCET with conditional actions.



Appendix

Timers:

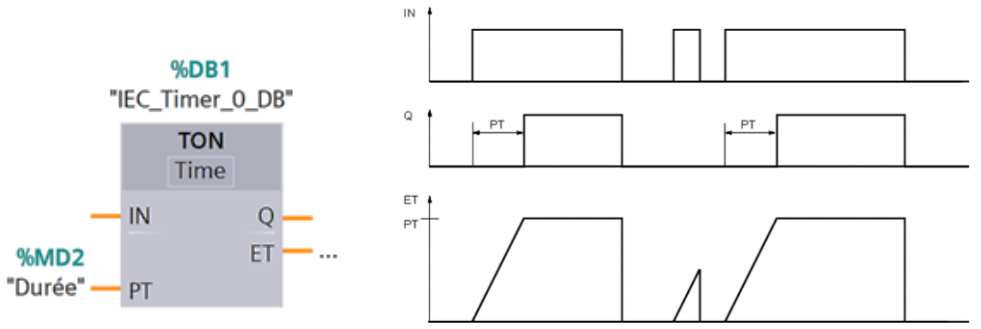


Figure.1. Operating principle of the TON timer.

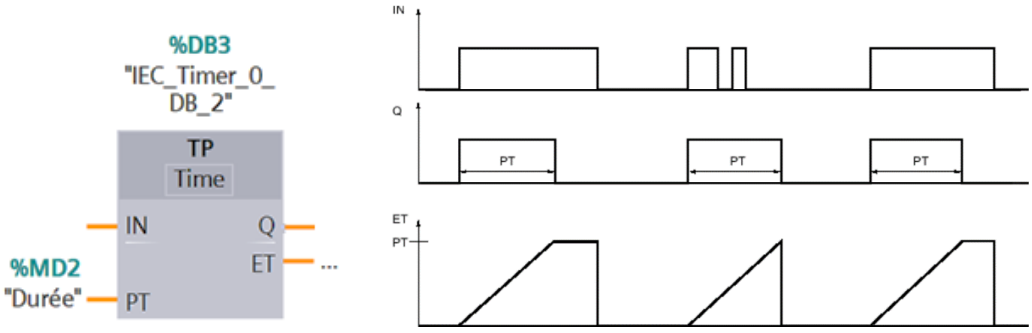
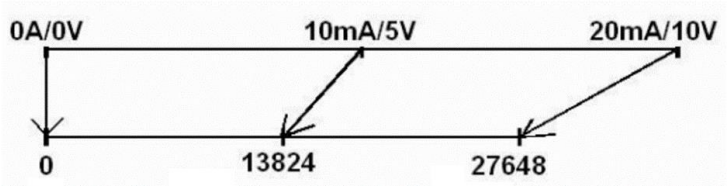


Figure.2. Operating principle of the TP timer.

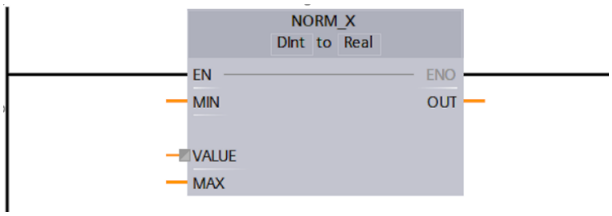
Analog-to-digital conversion (ADC)

The conversion of analog signals for PLC processing is the same for both analog inputs and outputs. Typical digitized value ranges include the following:



The '**Normalize**' instruction uses the following equation:

$$\mathbf{out} = \frac{\mathbf{value}-\mathbf{min}}{\mathbf{max}-\mathbf{min}} \quad , \; 0 < \text{out} < 1$$



The '**Scale**' instruction uses the following equation:

$$\mathbf{out} = \mathbf{value} \cdot (\mathbf{max} - \mathbf{min}) + \mathbf{min}$$