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

June 09, 2025
Duration: 01 :30H
Speciality: Control

Retake Exam

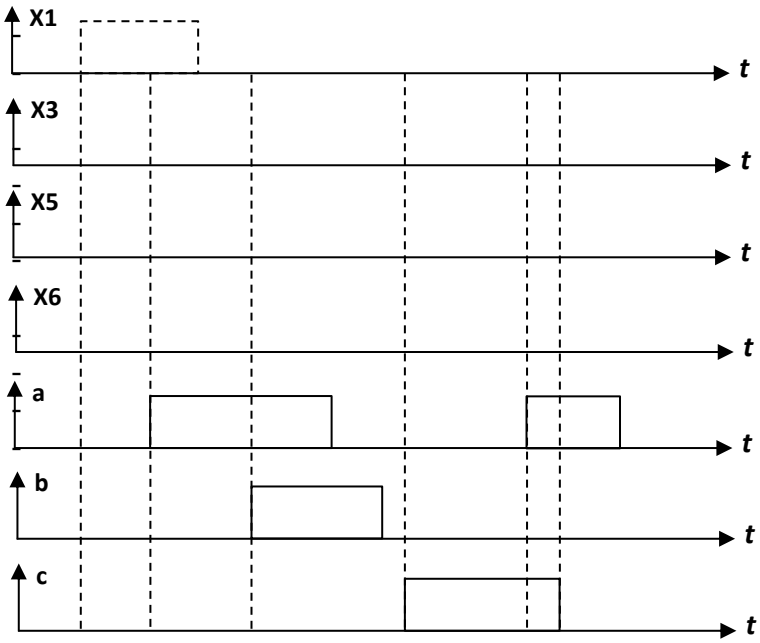
Exercise 1: (04.0 pts)

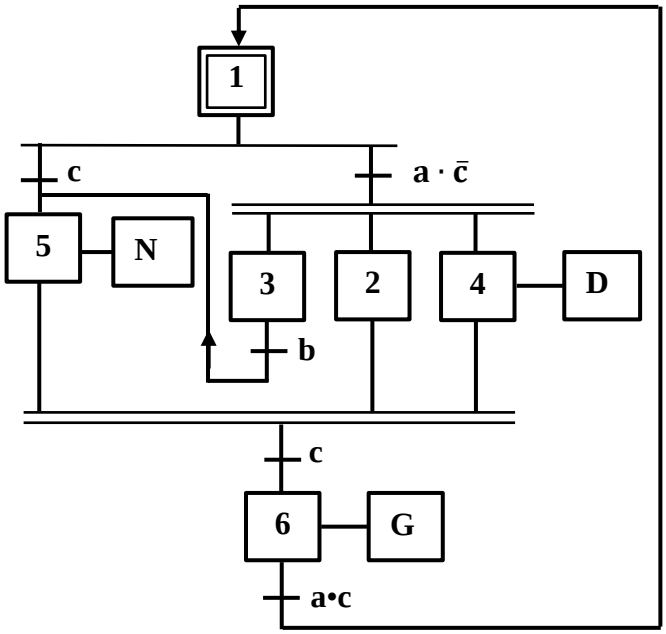
Answer the following course-related questions: p

1. List four factors that can affect the cycle time of a PLC. **(1.0 pts)**
2. Describe the operating principle of a PLC in five steps, then illustrate it with a diagram. **(1.5 pts)**
3. List the two main components that make up an automated system. **(0.5 pts)**
4. List two sensors, two pre-actuators, and three actuators. **(1.0 pts)**

Exercise 2: (04.0 pts)

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





Exercise 3: (6.0 pts)

A cable car uses three electric motors: **M1**, **M2**, and **M3**. Each motor is activated based on the load level **(LC)** to ensure smooth cabin movement.
The load capacity **(LC)** is categorized into three levels: low (**C1**), medium (**C2**), and high (**C3**). The motors are activated to maintain smooth and safe operation depending on **LC**:

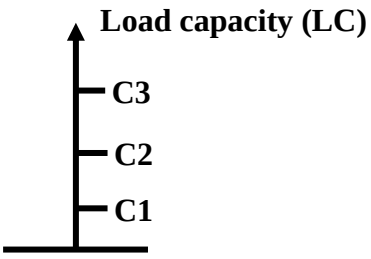
General Operating Conditions

The system operates only if the "**start**" switch is in the **ON** position (**start = 1**).
If **start = 0**, the system remains in its initial state, meaning that all motors are deactivated.

Operating Logic Based on Load Capacity (LC)

- If **LC < C2**, only motor **M1** operates.
- If the **LC** increases and reaches the C2 level **(LC ≥ C2),** motor **M2** is activated. However, if the load drops below the **C1** level, motor **M2** is deactivated (**M1** continues running).
- If the **LC** increases and reaches the **C3** level **(LC ≥ C3)**, motor **M3** is activated. However, if the load drops below the **C2** level, motor **M3** is deactivated (**M1 and M2** continue running).
- Describe the system using a GRAFCET.

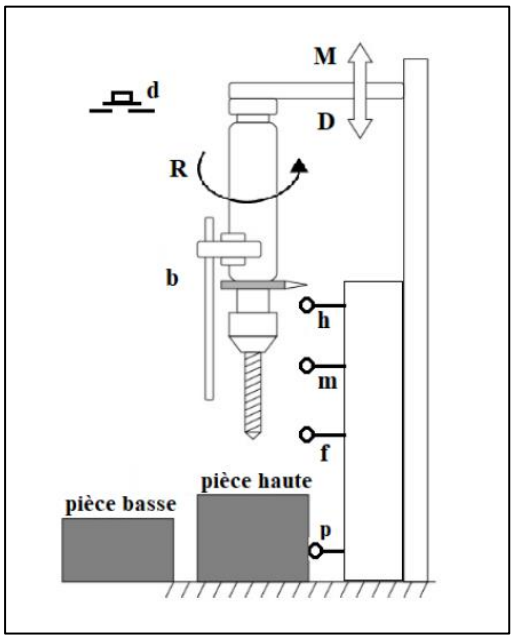
Unauthorized documents

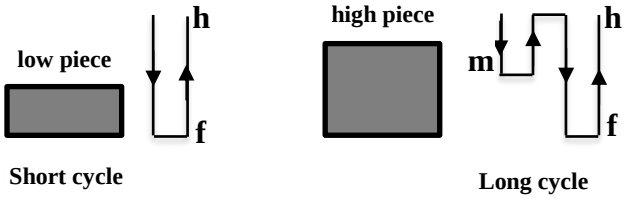


Exercise 4: (6.0 pts)

A drill performs a drilling cycle controlled by the input variables **d**, **h**, **m**, **f**, **b**, and **p**.

d: Cycle start push button
h: Upper limit switch contact
m: Midpoint switch contact
f: End-of-course switch contact
b: Piece height contact
p: Piece presence contact
M: Ascending motor
D: Descending motor
R: Rotation motor





Short cycle **Long cycle**

- R = 1 → Motor running
- R = 0 → Motor stopped

When the drill is at mid-course (**m = 1**):

- If the piece is low → b = 0
- If the piece is high → b = 1

The cycle begins when the push button '**d**' is pressed. The drill must be in the upper position, and a piece must be present. The pieces to be drilled can be of two types: **high piece** or **low piece**. The description of the two cycles, short and long, is shown in the figure above. Before starting a new cycle, the drilled piece must be removed and replaced.

- Describe the operation of the automation system using a Grafcet.