



MACHAKOS UNIVERSITY

University Examinations for 2020/2021

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

FIFTH YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (ELECTRICAL AND ELECTRONICS
ENGINEERING)

EEE 556: PROGRAMMABLE LOGIC CONTROLLERS

DATE: 9/8/2021

TIME: 8:30 – 10:30 AM

INSTRUCTIONS

Answer question **ONE** and **ANY OTHER TWO** questions

QUESTION ONE (COMPULSORY) (30 MARKS)

- a) Describe briefly the solutions that PLCs offer. (6 marks)
- b) For the on-delay timer program shown in Fig.Q1 (b)
 - i. When will output *B* be switched ON?
 - ii. When will output *C* be switched ON?
 - iii. When will output *D* be switched ON?
 - iv. When will the Timer accumulated value reset to zero?

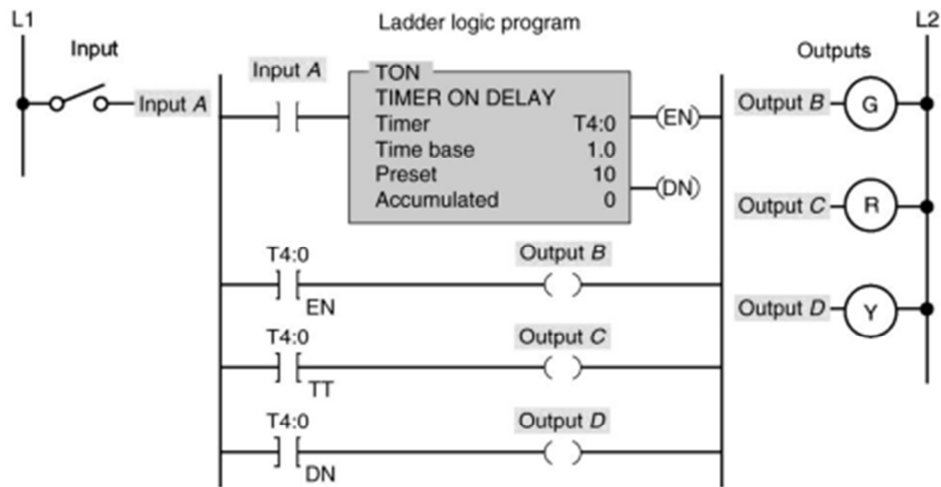


Fig.Q1 (b)

(9 marks)

- c) Describe briefly any **Three** IEC 61131-3 basic ladder logic coil (output) symbols. (6 marks)
- d) For the count -up counter program shown in Fig.Q1 (d)
- When will output PL2 energized?
 - When will output PL1 energized?
 - Which field device will cause the counter to increment?

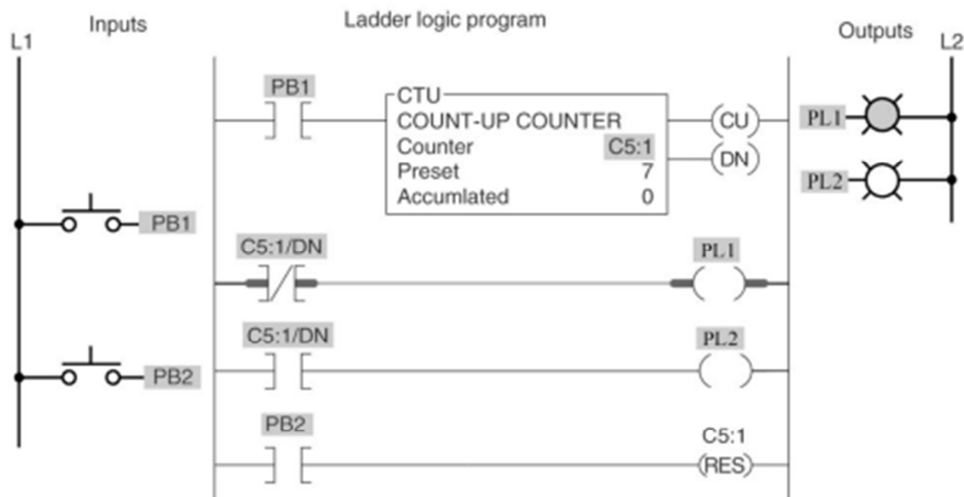


Fig.Q1 (d)

(9 marks)

QUESTION TWO (20 MARKS)

- a) Consider the diagram shown in Fig.Q2 (a)
- Is this **current sourcing, current sinking or relay output**?
 - How can you tell?
 - How do they differ?

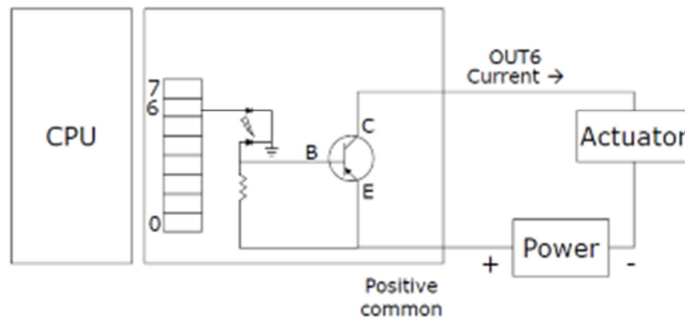


Fig.Q2 (a)

- b) Create the PLC ladder logic diagram for the following Boolean expression (5 marks)

$$Y = (AB)' + AC + CB$$

- c) For a NAND gate: (5 marks)
- Construct the equivalent relay circuit;
 - Construct the equivalent relay ladder logic circuit;
 - Construct the equivalent PLC ladder logic.

(10 marks)

QUESTION THREE (20 MARKS)

- a)
 - Distinguish between a de-facto and a de-jure standard;
 - List the **THREE** major elements of a protocol; (7 marks)

- b) Briefly describe the following.

- SCADA systems;
- SCADA architectures;
- DCS.

(13 marks)

QUESTION FOUR (20 MARKS)

- a) Describe briefly the solutions that Proportional–Integral–Derivative (PID) control offers. (6 marks)
- b) Consider the Ladder diagram/program in Fig.Q4 (b).

Explain what the program does, rung by rung, and what the overall function of the program is.

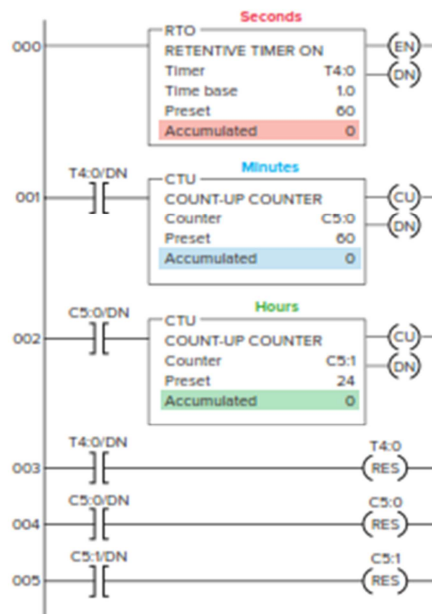


Fig.Q4 (b)

(14 marks)

QUESTION FIVE (20 MARKS)

Create a ladder logic program for Fig.Q53, including a symbol table and a status chart that satisfies the following specifications.

- When the START button is pressed, Valve 1 (V1) is energized and fluid enters the tank.
- As the tank begins to fill, Level Switch 2 (LS2), which detects the lower limit of the fluid level, closes.
- When the tank is full, the normally open Level Switch 1 (LS1), which detects the upper limit of the fluid, shuts off V1 and starts the Agitator (AG).
- AG mixes the fluid for 45 s and shuts off. When AG turns off, Valve 2 (V2) is energized to drain the fluid.
- After the tank has been emptied, LS2 opens and V2 shuts off.

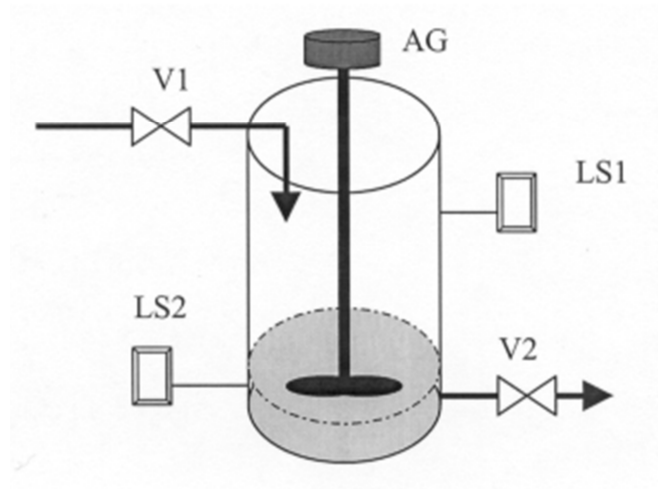


Fig.Q5