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## TECHNICAL UNIVERSITY OF MOMBASA

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### SCHOOL OF ENGINEERING AND TECHNOLOGY DEPARTMENT OF MEDICAL ENGINEERING

#### UNIVERSITY EXAMINATION FOR:

DIPLOMA IN REFRIGERATION

&

AIR CONDITIONING

EEP 2350:PROGRAMMABLE LOGIC  
CONTROLLERS

SPECIAL/SUPPLEMENTARY EXAMINATION

**SERIES:** MARCH 2022

**TIME:** 2 HOURS

**DATE:** MAR 2022

#### INSTRUCTIONS

You should have the following for this examination

- *Answer Booklet, examination pass and student ID*

This paper consists of FIVE Questions. Attempt question ONE (COMPULSORY), and any other TWO questions.

**Do not write on the question paper**

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## **Question1**

(COMPULSORY)

- (a) State any FOUR rules that must be observed when carrying out ladder programming.

(4 marks)

- (b) i) Explain the term *retentive memory coil*.  
ii) With an aid of a ladder diagram describe the operation of a backed battery circuit.

(7 marks)

- (c) Describe the sequence of events that take place during the run operation of a PLC.

(10 marks)

- (d) Compare the single-ended, multitask, and control management types of PLC applications.

(9 marks)

## **Question2**

- (a) State FOUR functions of optical isolator circuit used in discrete I/O module

(4 marks)

- (b) Explain any TWO differences between open and proprietary PLC architecture.

(4 marks)

- (c) Express each of the following Boolean expressions as a ladder logic program:

- i)  $Y = (A + B).C.D$
- ii)  $Y = A.\bar{B}.C + \bar{D} + E$
- iii)  $Y = [(\bar{A} + \bar{B}).C] + D.E$
- iv)  $(\bar{A}.B.\bar{C}) + (D.\bar{E}.F)$

(12 marks)

## **Question3**

- (a) State three advantages of using programmed PLC timers over mechanical timing relays.

(3 marks)

- (b) Identify the type of counter you would choose for each of the following situations:

- i) Count the total number of parts made during each shift.
- ii) Keep track of the current number of parts in a stage of a process as they enter and exit.
- iii) There are 10 parts in a full hopper. As parts leave, keep track of the number of parts remaining in the hopper

(3 marks)

- (c) One open tank is installed in a plant of which liquid level is to be controlled. When level reaches the Level Low, Outlet flow is blocked and inlet flow is allowed until high level is achieved. And when Level High is detected, outlet flow is allowed and inlet flow is blocked.

- i) Draw a sketch of the process.
- ii) Prepare a typical PLC program for this control process

(14 marks )

#### Question4

- (a) State the difference between the operation of a nonretentive timer and that of a retentive timer.

(3 marks)

- (b) FigureQ4 shows how a hardwired off-delay timer relay circuit with both instantaneous and timed contacts. Describe the operation of the circuit.

(7 marks)

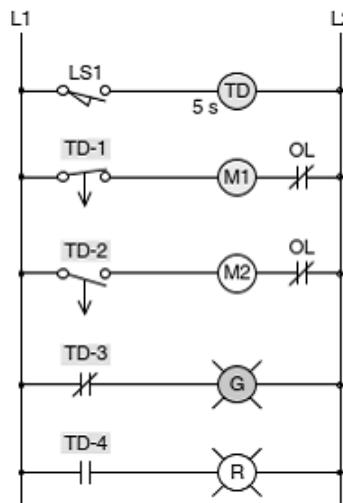


Figure Q4.

- (c) Write a program to implement this process:- When the lights are turned off in a building, an exit door light is to remain on for an additional 2 min, and the parking lot lights are to remain on for an additional 3 min after the door light goes out.

(10 marks)

### Question5

- (a) Name FOUR pieces of information usually associated with a PLC timer instruction.

(4 marks)

- (b) Figure Q5 shows the sketch of a continuous filling operation. This process requires that boxes moving on a conveyor be automatically positioned and filled. The sequence of operation for the continuous filling operation is as follows:

- Start the conveyor when the start button is momentarily pressed.
- Stop the conveyor when the stop button is momentarily pressed.
- Energize the run status light when the process is operating.
- Energize the standby status light when the process is stopped.
- Stop the conveyor when the right edge of the box is first sensed by the photosensor.
- With the box in position and the conveyor stopped, open the solenoid valve and allow the box to fill. Filling should stop when the level sensor goes true.
- Energize the full light when the box is full. The full light should remain energized until the box is moved clear of the photosensor.

Draw a ladder diagram to implement the process.

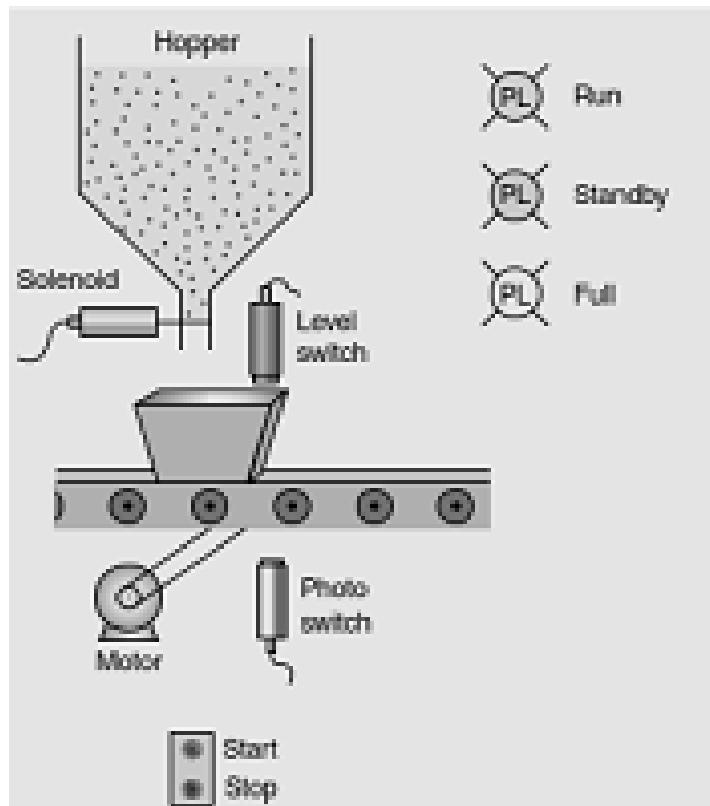


Figure Q5

(16 marks)