Question Paper

MANIPAL ACADEMY OF HIGHER EDUCATION

INTERNATIONAL CENTRE FOR APPLIED SCIENCES
IV SEMESTER B.Sc.(APPLIED SCIENCES) END SEMESTER EXAMINATIONS APRIL/MAY 2019
PROGRAMMABLE LOGIC CONTROLLER [IMET 242 - S2]

Marks: 100   **Duration: 180 mins.**

Answer 5 out of 8 questions.

1)

A) Define 'Lathing' in PLC operation and about the two types of Latch operations. (3)

B) Advantages of PLC over conventional Relay operation. (Minimum five points). (5)

C) Explaining the functions of the following blocks: a) CPU b) I/O Modules (4)

D) Design ladder diagram for XNOR gate and mention any four companies who manufacture PLCs. (4)

E) Design a ladder logic diagram to calculate the angular velocity (rpm) of the ceiling fan with the help of optical sensor as shown in Fig 1e. (Hint: use TON, two Up counters, Multiplication function block) (4)
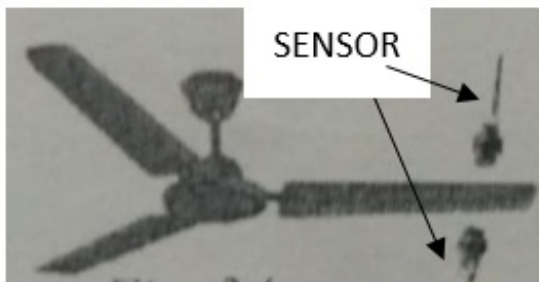

Fig. 1e

2)

A) Develop a ladder logic program that will give output 'B', 20 seconds after 'A' has been turned ON. After 'A' is pushed, there will be a 20 seconds delay, and the timer will reset. After 'A' has been pushed 3 times, 'B' should go OFF. (3)

B) An industry will add a logo to the manufactured parts. These parts travel along an assembly line via three stations (S1, S2 and S3) which takes 10s for the entire process.
S1: Sensor-1 will detect parts arrived. After this, the 'clamp' output is turned ON for 10 seconds to hold the part during the whole operation.
S2: For the first 2 seconds (out of the entire 10 seconds), the part is being (5)

held for 'spray' and then, Sensor-2 will be turned ON to apply the thermoset ink.

S3: For the last 8 seconds, a 'heating operation' will be turned ON to cure/dry the ink. After this, the part is released and allowed to continue along the line.

Develop a ladder logic diagram for the entire process.

C) With necessary block diagram/s, explain with example the difference between Analog control system and Discrete control system. (6)

D) Illustrate about the three stages and the necessary steps involved in Scan cycle. (6)

3)
A) Write a program that will turn ON a light along with a timer, when a count reaches 10. This light is then to go OFF when another timer exceeds 10 seconds. (4)

B) Mention any 5 Types of special purpose I/O modules in detail. (5)

C) Describe five levels of industrial control and mention where does PLC fit in the five levels. (7)

D) Using both a counter and arithmetic function blocks, draw a ladder logic for a light to be ON only when the number of pulses is between 18 and 26. (4)

4)
A) Draw ladder logic for the following expression: (3)

$$((1+\overline{2}+3)\,(4+5)\,(6 \times 8)) + ((\overline{11}+23).41) = Z$$

B) What is the specialty of 'Redundancy' in PLC? With neat diagrams, explain different types of redundant PLCs. Also, mention which among these configurations is recommended for SCADA applications. (6)

C) Explain the working and operation of DCS system with appropriate diagram which shows different levels of its operation. What is the main advantage of distributing the control tasks in DCS? (7)

D) Discuss in detail: R-TRIG and F-TRIG using ladder diagram. (4)

5)
A) Two conveyors (A and B) feed a main conveyor. The main conveyor count can only be determined from count of parts entering from other two conveyors. The count on each conveyor is determined by a counter. Assume ADD function is enabled every 30s. If the main conveyor count exceeds 20, a light should go ON. (5)

B) Sketch and Explain: (6)
   1. Sinking device with sourcing input module circuit.
   2. Sinking device with sourcing output module circuit.
   3. Sourcing device with sinking output module circuit.

C) Design a ladder diagram to control the operation of the entry gate of the automatic car parking system. Entry and exit of a car is detected by (5)

sensors. A PLC will keep a record of number of cars enter and exit. Maximum 50 cars can be in the parking area. The gate at the entrance (controlled by electric motor) will be kept open only when number of cars in the parking area is less than 50.

D) Explain about AC conditioning block and Filter section of Power supply of PLC. (4)

6)

A)
Elucidate the underlying principle of operation of HART protocol with a neat diagram. Also, discuss about it communication modes with neat diagrams. (6)

B) Using programmable logic controllers, write a program according to the following conditions: (3)
    1. If only one of the inputs (sensors) is turned ON, nothing will happen.
    2. If two of the inputs are turned ON, the Red Pilot Light will be activated.
    3. If three of the inputs is turned ON at same time, it would trigger an Alarm (siren).
    4. If all the four inputs are ON together, it would trigger an LED to the Fire Department which indicates about the fire.

C) What are the three highlighted attributes/characteristics of DCS? List any three types of DCS with suitable examples. (6)

D) Develop a ladder logic to implement the process described below as shown in Fig. 6(d): (5)
There are 3 groups participating in the quiz game: pupils, high school students and professors. If they want to get the chance of answering the question from the host, they must press the answer button on their table first. Other groups' pressing will be invalid if any group gets the chance successfully. There are two answer buttons for the pupil group and professor group and one answer button for the high school student group.
In order to give preferential treatment to the pupil group, Y0 will be ON if any one of X0 or X1 is pressed. However, in order to limit the professor group, Y2 will be ON when X3 and X4 are pressed at the same time. For the high school student group, Y1 will be ON when X2 is pressed. If the host presses X5 (Reset button), Y0, Y1, and Y2 will be OFF.
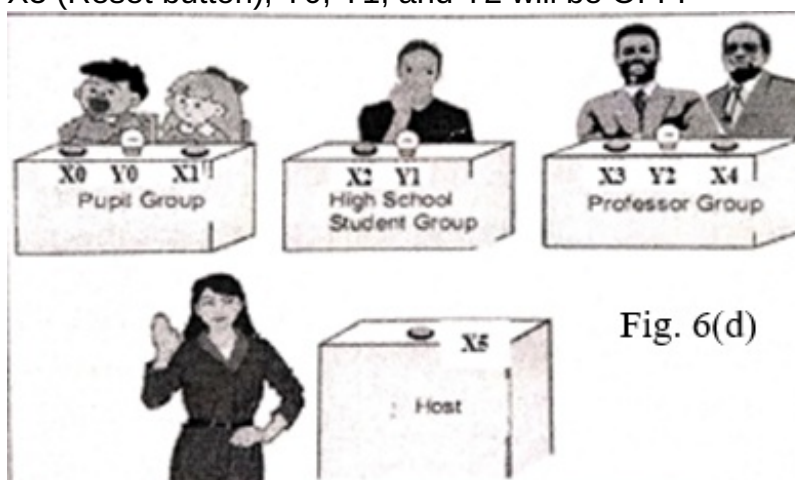

Fig. 6(d)

7)

A)
Sketch the different types of responses given by analog controllers including PID controller, where a dial is set to a position in degrees , Output device displays the position on dial. Assume that the user quickly turns the dial (6)

from 0 - 180 degrees in 3 seconds.

B) A conveyor is supposed to have exactly 45 parts on it. There are 3 indicating lights to indicate conveyor count status: (5)

> Less than 45-Yellow
> Exactly 45- Green
> More than 45- Red.

There are 2 sensors on conveyor. One is actuated by Parts entering the conveyor and other is activated by Parts exiting the conveyor.

C) Design ladder logic that uses normal timers and counters to measure time of 50 days. Note: Measure minutes, hours and days. (3)

D) Mention and explain in detail about the three types of electrical conductors (copper wire) used for transfer of data signals between devices. (6)

8) Elaborate on various types of memory utilized for PLC. (At least 5 types) (5)

A)

B) Define the following in terms of control system: (4)
(i) Process variable
(ii) Error signal
(iii) Set point
(iv) Controller

C) A motor will be controlled by two switches. The Go switch will start the motor and the Stop switch will stop it. If the Stop switch was used to stop the motor, the Go switch must be thrown twice to start the motor. When the motor is active a light should be turned ON. The stop switch will be wired as normally closed. (2)

D) Construct a ladder logic diagram that will implement the following function. If the result is greater than 150, then an output light 'P' will be turned ON. Assume A, B and C are inputs. (5)

$X = \ln [10 + A(B\cos^{-1}(4C+5))^2]$

E) Simulate the following function using ladder logic: (4)

$$Y = (A \, \overline{BC} \oplus D) + (E \, \overline{D} \, F) \, C$$

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