53 (IE 712) CCPR

2017

COMPUTER CONTROL OF PROCESS

Paper : IE 712

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions taking at least **two** questions from each group.*

Group-A

1. *(a)* Draw and explain with schematic diagram of a typical SCADA system general layout and the basic SCADA communication topologies. 10

   (b) List and explain the network components of an integrated control system (ICS). 10

2. *(a)* Explain the aspect system technology for distributed control system. 5

   (b) Describe the characteristics of Field Bus. 5

   (c) Draw the ladder configuration for the following gates :

   (i) OR gate

Contd.

(ii) AND gate

(iii) NOR gate

(iv) NAND gate

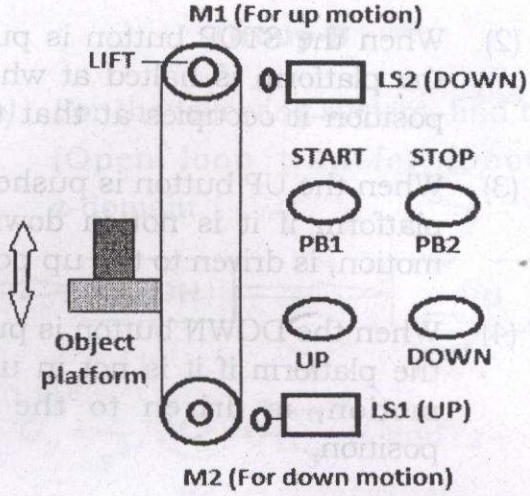
(v) XOR gate 10

3. (a) What is the relationship between hierarchical level, the response time, data quantity and complexity ? 10

(b) Write a short note on (i) OSI model and data packet flow of information and (ii) expert system structure, forward and backward chaining. 5+5

4. (a) Prepare a ladder diagram to implement the control function as per description below.

The elevator employs a platform to move objects up and down. The global objective is that when the UP button is pushed, the platform carries something to the up position, and when the DOWN button is pushed, the platform carries something to the down position. The following hardware specifications define the equipment used in the elevator :



Output Elements

M1 - Motor to drive the platform up

M2 - Motor to drive the platform down

Input Elements

LSI — NC limit switch to indicate UP position

LS2 — NC limit switch to indicate DOWN position

START — NO push button for START

STOP — NO push button for STOP

UP—NO push button for UP command

DOWN—NO push button for DOWN command

The following narrative description indicates the required sequence of events for the elevator system :

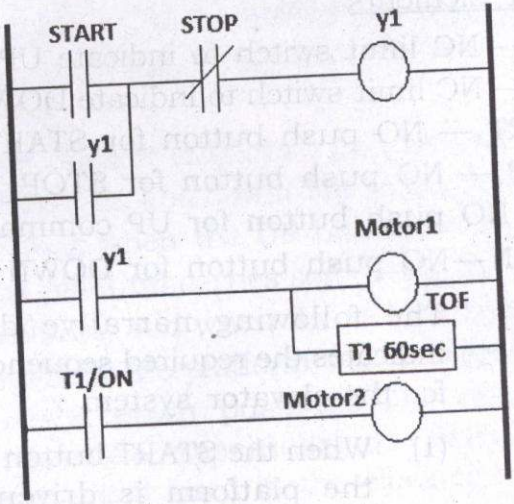
(1) When the START button is pushed, the platform is driven to down position

(2) When the STOP button is pushed, the platform is halted at whatever position it occupies at that time

(3) When the UP button is pushed, the platform if it is not in downward motion, is driven to the up position

(4) When the DOWN button is pushed, the platform if it is not in upward motion, is driven to the down position. 10

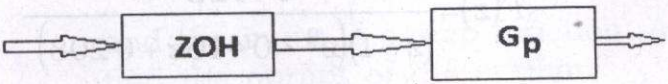
(b) Explain the operation of the following PLC ladder diagram when *(i)* START button is pressed *(ii)* STOP button is pressed. 10



Ladder diagram

Group-B

5. *(a)* For the following system, find the OLTF (Open loop transfer function) in z-domain : 6



Where $G_p = \frac{1}{s^2}$, $ZOH = \frac{1-e^{-st}}{s}$ and $z = e^{sT}$

(b) What are the different algorithms used for implementation of analog controllers? Derive the algorithms for PID controller using backward rectangular rule for integration. 7

(c) Derive the difference equation of $u(k)$ vs. $e(k)$ for PID Control using trapezoidal rule for integration tem. Find the change in output at third sample for the following data : $K_p = 2$, $T = 0{\cdot}4\,sec$, reset time $= 2\,sec^{-1}$, derivative time $= 6\,sec$, $e_1 = 1$, $e_2 = 2$ and $e_3 = 3$. 7

6. (a) State initial value theorem (IVT) and final value theorem (FVT) for Z-transformation. Find the final value of $f(k)$ using FVT for a given function

$$F(z)=\frac{0{\cdot}792z^2}{(z-1)(z^2-0{\cdot}416z+0{\cdot}208)}$$ 7

(b) Using the Z-transformation, find $X(z)$ when $x(k)=\left(\frac{1}{2}\right)^k$ for $k = 0,1,2,3,\ldots$ 6

(c) Using inverse Z-transformation, find $x(k)$ when $X(Z)=\frac{11z^2-7z}{z^2-1{\cdot}3z+4}$ for $k=0,1,2,3,\ldots$ 7

7. (a) Derive the generalized equation of a controller for a digital control system. Using this equation, derive Deadbeat controller algorithm. 12

(b) Determine Deadbeat controller parameter when transfer function of a digital control system is represented as

$$G_p(z)=\frac{0{\cdot}05(z+0{\cdot}5)}{(z-0{\cdot}9)(z^2-1{\cdot}1z+0{\cdot}24)}$$

and the input is a step function. Also find the output of the system. 8

8. Write a short note on ***any four*** of the following : 4×5 =20

(a) Advantages of digital control system over conventional control system

(b) Stability of discrete data system

(c) Signal discretization technique

(d) Jury's stability test

(e) Pole placement controller.