53 (IE 712) CCPR

2014

COMPUTER CONTROL OF PROCESS

Paper : IE 712

Full Marks : 100

Pass Marks : 30

Time : Three hours

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

*Answer **any five** questions out of seven.*

1. *(a)* A discrete-time system is described by the state equation

$$y(k+2)+5y(k+1)+6y(k)=u(k)$$

Determine the state model in canonical form. 5

(b) Determine the stability of sample-data control system having following characteristics equation

$$2z^6+2z^5+5z^4+7z^3+10z^2+4z+1=0$$

5

Contd.

(c) A continuous-time plant of a sampled data system is described by the state equation

$$\dot{x} = \begin{bmatrix} 0 & 2 \\ -4 & 0 \end{bmatrix} x + \begin{bmatrix} 0 \\ 2 \end{bmatrix} u$$

Determine the value of sampling period T, which make the system uncontrollable. 10

2. (a) Find the Z transform of the following : ***(any two)*** 8

(i) $f(t) = 2u(t) + t$

(ii) $e^{-at} \sin wt$

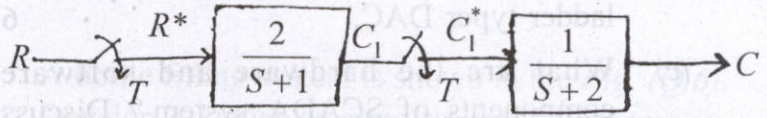
(iii) t^2

(b) Find the inverse Z transform of the following : 8

(i) $\dfrac{z}{(z+1)(z+2)}$

(ii) $\dfrac{2 - 0{\cdot}4}{z^2 + z + 2}$

(c) Determine pulse transfer function for the sampled data control system shown in *Fig.2(c).* 4



3. The block diagram of a sampled-data control system is shown in the drawing of *Fig (Q.3).* The sampling period is $\Delta t = 1 min$.

(a) Design the digital controller $D(z)$ so that closed-loop system exhibits a minimal prototype response to a unit step change in the load variable L.

(b) Design a digital PID controller based on the ITAE (set point) criterion and examine its performance for a step change in the set point. 20

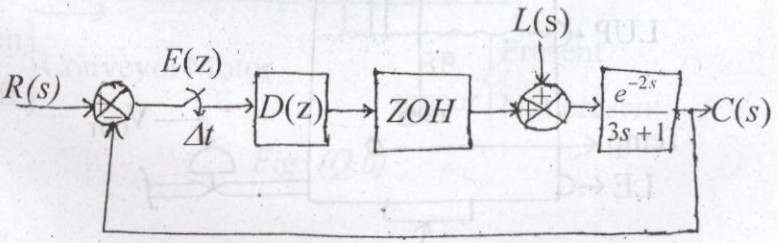


Fig. (Q.3)

4. *(a)* What is data acquisition ? Describe the data acquisition system with neat and proper block diagram. 8

(b) Discuss briefly the operation of a R-2R ladder typer DAC. 6

(c) What are the hardware and software components of SCADA system ? Discuss them briefly with neat sketch. 6

5. *(a)* What is PLC ? Explain the operation of PLC with block diagram. 2+8

(b) Draw a ladder diagram for the control problem shown in *Fig. (Q.5b)*. The global objective is to heat a liquid to a specified temperature and keep it there with stirring for 30*min.* The hardware has the following characteristics

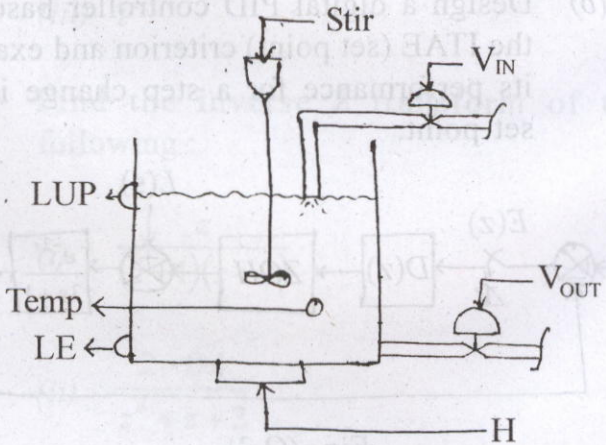


Fig. (Q.5b)

(i) START push button is NO, STOP is NC.

(ii) NO and NC are available for the limit switches. 10

6. A bottle filling system is shown in the *Fig. (Q.6)*. Develop a ladder diagram to run the process. 20

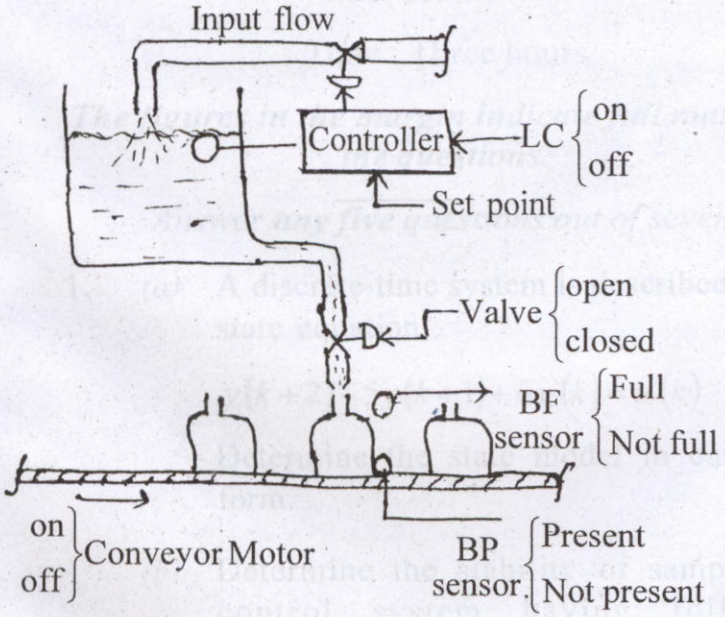


Fig. (Q.6)

7. Write short notes on : ***(any four)*** 4×5

(a) Genetic algorithm

(b) Dahlin's algorithm

(c) Relay *Vs* PLC

(d) Digital PID controller

(e) Fuzzy Logic.
