**53 (IE 712) CCPR**

**2016**

# 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 out of **Seven**.*

1. *(a)* With the help of the typical block diagram briefly explain the operation of a computer control system. 5

(b) How the sampling period effect on the stability of a system ? Investigate the stability of the system shown in *Fig.* (1.*b*) for sampling period (T) = 0·5 *sec* and 2·5 *sec.*

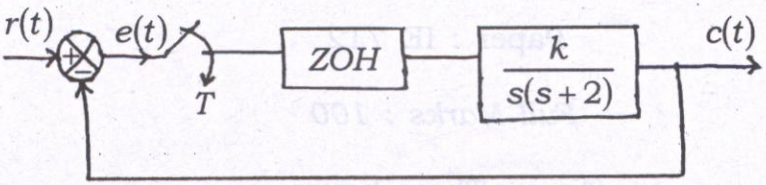


*Fig.* (1.*b*)

15

2. (a) Consider the following discrete transfer function 5+5

$$G(z) = \frac{z+4}{z^2+z+1}$$

Find the state model of the system in

(i) Phase variable form

(ii) Jordan Canonical form

(b) A discrete-time system is described by the state equation

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

$$y(0)=y(1)=0; \quad T=1\,sec.$$

(i) Find the state transition matrix.

(ii) For input $u(k)=1$ for $k\geq 0$, find the output $y(k)$. 5+5

3. (a) Discuss the position algorithm of a digital PID controller. 5

(b) Briefly explain some features of the digital PID controller. 5

(c) What is state observer ? Determine the appropriate observer gain matrix ke of the system

$$\dot{x}=Ax+Bu$$

$$y=cx$$

where, $A=\begin{bmatrix}0 & 20\\ 1 & 0\end{bmatrix}$; $B=\begin{bmatrix}0\\ 1\end{bmatrix}$; $C=[0 \quad 1]$

Assume the desired eigenvalues of the observer matrix are, $\mu_1=-10$, $\mu_2=-10$. And the system is state feedback i.e. $\mu=-kx^2$. 2+8

4. *(a)* Draw a typical grounding installation diagram of a Distributed Control System (DCS) and explain the following terms :

*(i)* Environmental Conditioning

*(ii)* Power source quality

*(iii)* Intrinsically safe barrier

*(iv)* Cable characteristics. 10

*(b)* In a Programmable Logic Controller (PLC) what are the technical specifications that should be considered for selecting —

*(i)* Digital Input Module

*(ii)* Digital Output Module 10

5. *(a)* What are the control panel specifications for selecting a PLC/DCS ? 5

*(b)* *Fig.* (5.*b*) shows a system for batch processing. The system operations can be described as follows :

*(i)* A weighed quantity of dry material is added to liquid that has filled the tank to level L1.

(ii) The mixture is stirred, and heat is applied to maintain the temperature between TL and TH for a period of 10 minutes.

(iii) With the stir and heater off, the batch is emptied down to level L2. The whole process then starts again. Prepare a flowchart that describes the sequence of events. Also prepare a PLC ladder diagram of the flowchart. 15

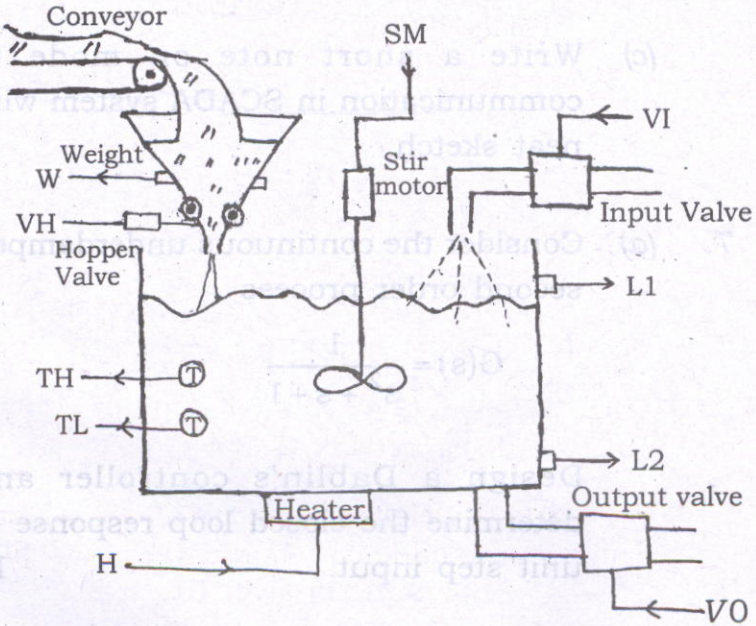


*Fig.* (5.*b*)

6. *(a)* A temperature between $100°C$ and $300°C$ is converted into a 0 to $5V$ signal. This signal is fed to an 8-bit ADC with $5V$ reference. What is the actual range of the system ? What is the resolution ? 5

*(b)* What is Fuzzy logic ? How this logic is implemented in control system engineering ? Explain with an example. 10

*(c)* Write a short note on mode of communication in SCADA system with neat sketch. 5

7. *(a)* Consider the continuous underdamped second order process

$$G(s) = \frac{1}{s^2 + s + 1}$$

Design a Dablin's controller and determine the closed loop response to unit step input. 10

(b) List out the advantages of SCADA system in Transmission and Distribution network for a smart city. 5

(c) Write a short note on :

R-2R ladder DAC. 5

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