53 (IE 712) CCPR

2013

(May)

COMPUTER CONTROL OF PROCESS

Paper : Theory (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

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

$$y(0)=y(1)=o;T=1sec$$

i) Determine a state model in canonical form.

ii) Find the state transition matrix.

iii) For input $u(k) = 1$ for $k \geq o$, find the output $y(k)$. 15

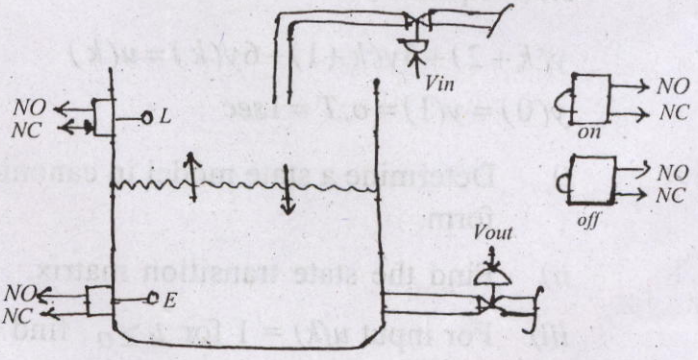
Contd.

b) Determine the stability of sample-data control system having following characteristics equation using Jury's Stability test.

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

2. a) Write down the mode of operation of PLC. Why PLC is preferred over relay logic control ? 3+2

b) Design a PLC ladder diagram for a tank system shown in the *Fig*(2.*b*). When the system turned ON, the tank alternately fills to level L and then empties to level E. The level switches are activated on a rising level. Both NO and NC connections are available for the level switches and the ON/OFF push buttons. 15



Fig(2.*b*)

3. *a)* Find the Z transform of the following

i) $e^{at}\ sinwt$

ii) t^2

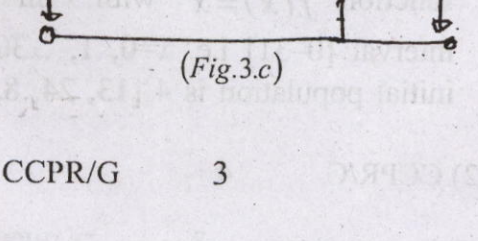
iii) K^2 9

b) Find the Z domain transfer function

i) $\dfrac{a}{s^2-a^2}$

ii) $\dfrac{a}{(s+b)^2+a^2}$ 6

c) Consider the system shown in (*Fig* 3.*c*). Derive the difference equation describing the system dynamics when the input voltage is piecewise constant, i.e. $e(t)=e(kt)$ for $kT \le t \le (k+1)T$; $T=1\,sec.$ 5



(*Fig.3.c*)

4. *a)* What is SCADA? Write some applications of SCADA. 2+3

b) Discuss the components of SCADA with the typical SCADA platform. 10

c) What necessary actions are taken to protect a SCADA system against threads ? 5

5. *a)* What is a Data Acquisition System ? Draw a DAS block diagram and explain briefly *each* block. 10

b) Explain briefly with neat sketch the basic building blocks of a computer control system. 5

c) A control valve has a linear variation of opening as the input voltage varies from 0 to 10V. A microcomputer outputs an 8-bit word to control the valve opening using an 8-bit DAC to generate the valve voltage. Find the reference voltage required to obtain a full open valve (10V). 5

6. *a)* Write the basic principle of Genetic Algorithm. Using this algorithm maxize the function $f(x)=x^2$ with x in the integer interval [0–31] i.e. x=0, 1, ...30, 31. Take initial population is 4 [13, 24, 8, 20]. 10

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

7. Write short notes on : ***(any four)*** 4×5=20

a) Dead beat control algorithm

b) Dahlin's algorithm

c) Timer applications on PLC

d) Digital PID control

e) R-2R Ladder DAC

f) Successive approximation type ADC
