53 (IE-712) CCPR

2015

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) Find the Z transform of the following :

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

   (ii) $f(t)=e^{-at} \sin wt$ 6

   (b) Find the inverse Z transform of the following :   6

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

(ii) $\dfrac{z - 0\cdot4}{z^2 + z + 2}$

(c) Investigate the stability of the system shown in *Fig.* (1.C) for sampling period $T = 1\,sec$. 8

$r(t) \longrightarrow$ $\underset{}{\bigotimes}$ $\xrightarrow{e(t)}$ $e(k)$ $\boxed{ZOH}$ $\longrightarrow$ $\boxed{\dfrac{k}{S(S+2)}}$ $\longrightarrow c(t)$
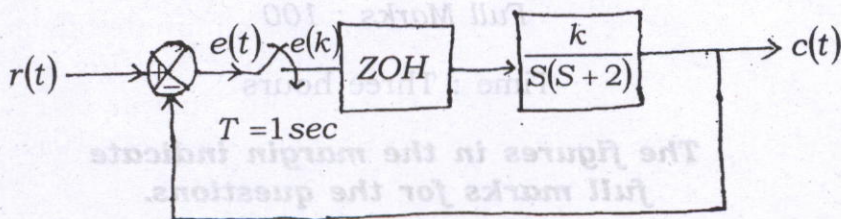
$T = 1\,sec$

Fig. (1.C)

2. (a) A discrete-time-system has the transfer function

$$T(z) = \dfrac{4z^3 + 12z^2 + 13z + 7}{(z - 1)(z - 2)}$$

Determine the state model of the system in phase-variable form. 5

(b) The block diagram of a sampled-data control system is shown in *Fig (2.b)*. The sampling period is $\Delta t = 1 min$.

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

    (ii) Will this controller eliminate offset after a step change in the set point ? Justify your answer.

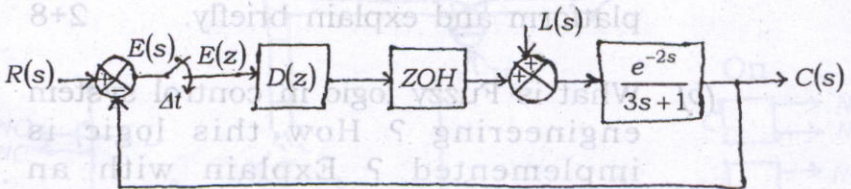<div align="right">10+5</div>

Fig.(2.b)

3. *(a)* Draw the blockdiagram for a Data Acquisition System (DAS) and discuss each block briefly.   5

(b) Find the successive approximation ADC output for a 6 bit converter to a 5·125 input if the reference is 10V.   5

(c) For a n-bit binary weighted DAC circuit find output voltage, current, and resolution for a binary word 1001.

Also, $R = 10K\Omega, R_f = 5K\Omega, V_R = -10V$.

What are the limitations of this type of DAC ? Suggest the suitable network to remove these limitations.   10

4. *(a)* What is SCADA ? Draw a typical SCADA platform and explain briefly.   2+8

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

5. *(a)* What is PLC ? Write the basic components of PLC with neat sketch and brief description.   5

(b) Design a PLC ladder diagram for a motor with the following :

No Start button

No stop button

thermal overloads limits switch opens on high temperature, green light when running, red light for thermal overload.

5

(c) Design a PLC ladder diagram for a tank system shown in the *Fig. (5.c)*. 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.
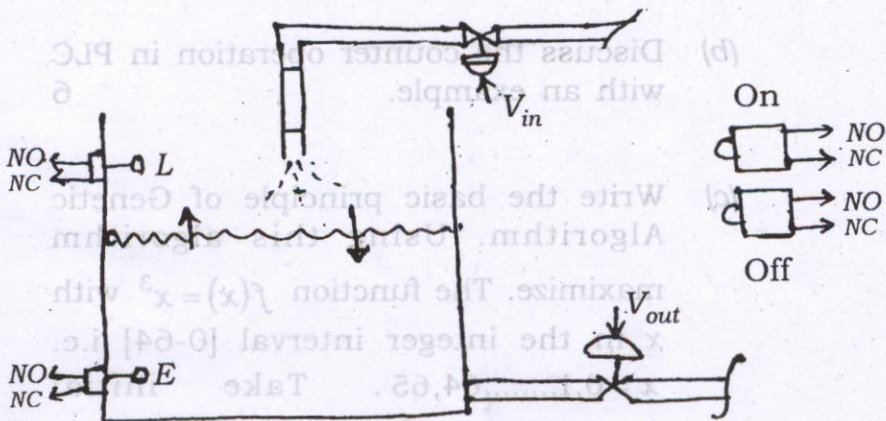
10

Fig.(5.c)

6. (a) Write the Boolean equation and draw the PLC ladder diagram for the logic diagram shown in *Fig. (6.a)*.   4
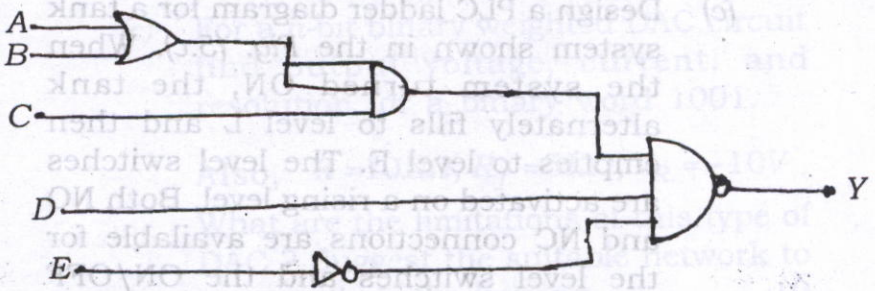

Fig.(6.a)

(b) Discuss the counter operation in PLC with an example.   6

(c) Write the basic principle of Genetic Algorithm. Using this algorithm maximize. The function $f(x) = x^3$ with x in the integer interval [0-64] i.e. $x = 0, 1, \ldots\ldots 64, 65$. Take initial population is $4[12, 26, 5, 60]$.   10

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

(a) Dead beat's algorithm

(b) Digital PID controller

(c) Jury's Stability test

(d) Timer applications on PLC

(e) PLC Vs Relay.