53 (IE 712) CCPR

2014

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 : 6

   (i) $e^{at} \cos wt$

   (ii) $t e^{at}$

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

   (i) $\dfrac{3z^2 + z + 1}{z^2 + 3z + 1}$

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

(c) Investigate the stability of the system shown in *Fig. (1.C)* for sampling period $T = 0{\cdot}4\,sec$.

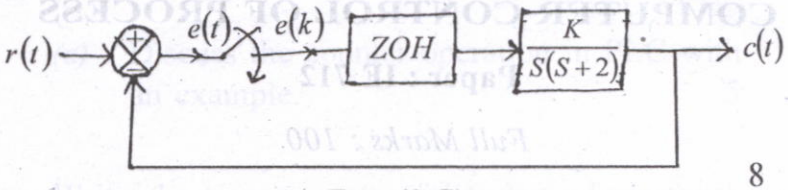

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Fig. (1.C)

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

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

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. 10+5

3. (a) Draw the appropriate block diagram for a Data Acquisition System and discuss each block briefly. 6

(b) A temperature between $100°C$ and $300°C$ *is* converted into a 0 to $5 \cdot 0V$ signal. This signal is fed to an 8-bit ADC with a $5 \cdot 0V$ reference. What is the actual range of the system ? What is the resolution ? What hex output results from $169°C$? 4+3+3

(c) Find the successive approximation ADC output for a 4 bit converter to a $7 \cdot 125V$ input if the reference is $10V$. 4

4. (a) Draw the basic building blocks of a computer control system. Explain briefly. 5

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

(c) Write the basic principle of Genetic Algorithm with an example. 5

5. (a) Prepare the physical ladder diagram for the control problem shown in *fig.(5.a)*. The global objective is to heat a liquid to a specified temperature and keep it there with stirring for 30*min*. 10

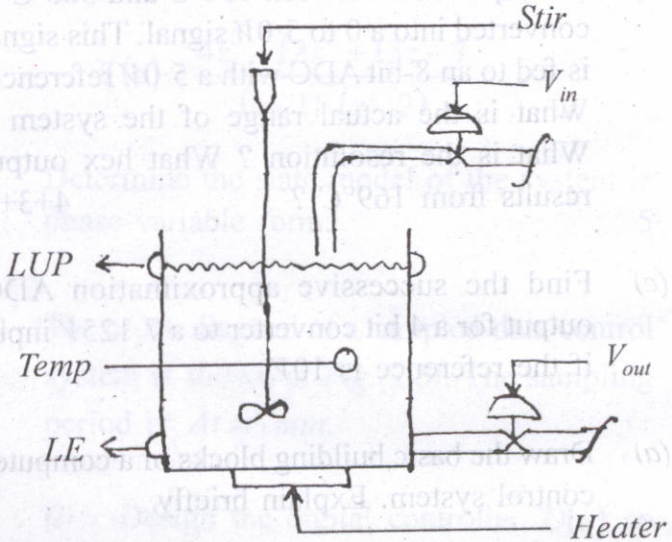

Fig. (5.a)

(b) Write the basic components of PLC with neat sketch and brief description. 5

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

NO start button

NC stop button

thermal overloads limit switch opens on high temperature, green light when running, red light for thermal overload. 5

6. (a) Write the Boolean equation and draw the PLC ladder diagram for the logic diagram shown in *Fig.(6.a)*. 5

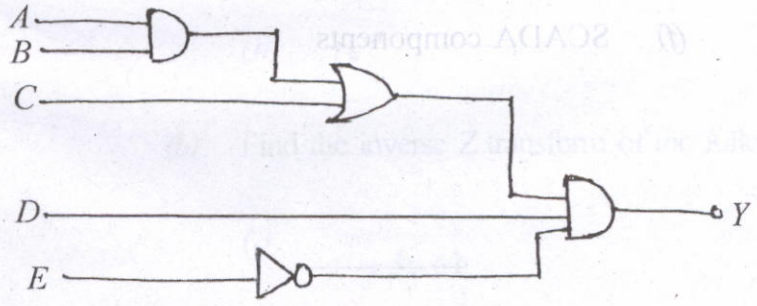

Fig.(6.a)

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

(c) Discuss the counter operation in PLC with an example. 5

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

(a) Digital PID controller

(b) R-2R Ladder DAC

(c) Dead beat's algorithm

(d) Relay Vs. PLC

(e) Jury's stability test

(f) SCADA components

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