Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech(ECE-NEW)/SEM-7/EC-704D/2009-10

2009

PROCESS CONTROL ENGINEERING

Time Allotted : 3 Hours *Full Marks* : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following : 10 × 1 = 10

i) The recommended sampling time in seconds for pressure control loop is

a) 1 - 3 b) 5 - 10

c) 1 - 5 d) 10 - 20.

ii) The antialiasing filter is used in a digital control loop is

a) discretize the continuous time signal

b) reconstruction of the discrete signal

c) suppress the unwanted noise

d) reduce the quantization effect.

iii) The actuation device that should be connected to the analog O/P of a PLC is

a) solenoid

b) motor starter

c) regulatory control valve with pneumatic actuator

d) lamp.

iv) Normally DCS based control loops controllers are

a) *P*-type b) *I*-type

c) *PID*-type d) none of these.

v) In fuzzy-logic system, the membership function is part of

a) rule base b) data base

c) fuzzification technique d) none of these.

vi) Size of PLC depends on

a) its geometrical size

b) its no. of input and output

c) area of plants

d) all of these.

vii) A batch process control is

a) transient under normal conditions

b) continuos under normal conditions

c) ON-OFF under normal conditions

d) none of these.

viii) Harriott method is a method of

a) closed loop response method

b) open loop method

c) open loop response method

d) none of these.

ix) In SMART transmitter input and output signals are respectively

a) analog and digital b) analog and analog

c) digital and digital d) digital and analog.

x) In a PLC, for every I/O channel, there is a corresponding

a) relay within the PLC

b) memory location within the PLC

c) memory location in a RAM outside PLC

d) none of these.

xi) The voltage for internal operation, a PLC is

a) 0-5 volt DC b) 5-15 volt DC

c) 5-15 volt DC d) 220 volt AC.

xii) An example of an Industrial Control System (ICS) is

a) PLC b) DCS

c) both PLC and DCS d) none of these.

GROUP – B
(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. a) What are the different international Field Bus standards for DCS ?

b) What is meant by data highway ? Why is fibre optic more attractive for data highway design ? 3 + 2

3. Explain with an example a total interaction system. Define relative gain matrix. 5

4. What is a heat exchanger ? Explain with a block diagram of heat exchanging process of any plant. 5

5. Draw the basic block diagram of a fuzzy logic based control system. What is membership function ? 3 + 2

6. What is field control element ? Prove that control valve sizing is $m = C_v \, sqrt \, (\Delta P/G)$

where m = flow rate

C_v = size coefficient

G = specific gravity of the liquid

ΔP = pressure differential. 5

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

7. a) How a time proportional controller different from on-off controller ? What is integral saturation ? $2\frac{1}{2} + 2\frac{1}{2}$

b) Explain a digital control loop with computer as a controller. Draw its block diagram and explain each part briefly. Why is the process part and measurement part different in that same loop ? 10

8. a) What do you mean by 'Pairing controlled and manipulated variables' ? Explain with suitable example. 3

b) What is relative process gain ? 3

c) Derive the resultant matrix for considering 'Blending' case, where both flow rate and compositions are to be controlled

where X and Y are blended to a specified total flow of composition x. 9

9. a) What is process reaction curve ? 2

b) Explain the open loop method for tuning of controller. 4

c) What is degree of freedom ? Explain with a suitable example. 2 + 2

d) Derive an expression for the collection efficiency of Howard's particulate collector unit. 5

10. a) What are the advantages of PLC over relay systems ? 2

b) Draw the block diagram of PLC and explain, briefly the priciple of operation. 2 + 3

c) Explain how PLC can be used for process control application. 4

d) Convert the following logic diagram to its equivalent PLC ladder diagram. 4

11. Write short notes on any *three* of the following :

a) Impulse response method for testing

b) Multi-input multi-output system

c) DSP processor based control

d) Model fitting technique

e) Pulse testing technique.