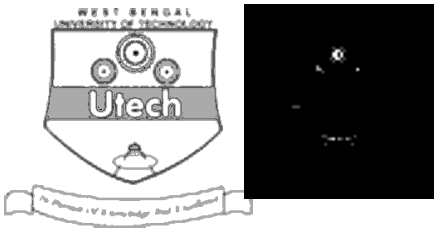
PROCESS CONTROL-I (SEMESTER - 6)

CS/B.Tech(EIE-N)/SEM-6/EI-601/09



1. .....
Signature of Invigilator

2. .....
Signature of the Officer-in-Charge

Reg. No. | | | | | | | | | | | | | | |

Roll No. of the Candidate | | | | | | | | | | | | | | |

CS/B.Tech(EIE-N)/SEM-6/EI-601/09

ENGINEERING & MANAGEMENT EXAMINATIONS, JUNE – 2009

PROCESS CONTROL-I (SEMESTER - 6)

Time : 3 Hours] [Full Marks : 70

INSTRUCTIONS TO THE CANDIDATES :

1. This Booklet is a Question-cum-Answer Booklet. The Booklet consists of **36 pages**. The questions of this concerned subject commence from Page No. 3.
2. a) In **Group – A**, Questions are of Multiple Choice type. You have to write the correct choice in the box provided **against each question**.
   b) For **Groups – B** & **C** you have to answer the questions in the space provided marked 'Answer Sheet'. Questions of **Group – B** are Short answer type. Questions of **Group – C** are Long answer type. Write on both sides of the paper.
3. **Fill in your Roll No. in the box** provided as in your Admit Card before answering the questions.
4. Read the instructions given inside carefully before answering.
5. You should not forget to write the corresponding question numbers while answering.
6. Do not write your name or put any special mark in the booklet that may disclose your identity, which will render you liable to disqualification. Any candidate found copying will be subject to Disciplinary Action under the relevant rules.
7. **Use of Mobile Phone and Programmable Calculator is totally prohibited in the examination hall.**
8. You should return the booklet to the invigilator at the end of the examination and should not take any page of this booklet with you outside the examination hall, **which will lead to disqualification**.
9. Rough work, if necessary is to be done in this booklet only and cross it through.

No additional sheets are to be used and no loose paper will be provided

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FOR OFFICE USE / EVALUATION ONLY

Marks Obtained

	Group – A										Group – B				Group – C				
Question Number																		***Total Marks***	***Examiner's Signature***
Marks Obtained																			

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Head-Examiner/Co-Ordinator/Scrutineer

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GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following : $10 \times 1 = 10$

i) A unit step input to a process having transfer function, $G_p(s) = \frac{12}{s^2 + 2s + 4}$ will give an output at steady-state as

a) 12 b) 6

c) 4 d) 3. ☐

ii) The temperature range of a temperature controller is 250°C to 550°C. If the set point is 400°C, what is the error in per cent of maximum span ?

a) + 5% b) + 1·67%

c) – 3·33% d) none of these. ☐

iii) The proportional sensitivity is maximum in

a) P controller b) PD controller

c) PID controller d) I controller. ☐

iv) Ratio control system is a special type of

a) open loop system b) feedback system

c) on-off system d) feed forward system. ☐

v) Response of Feed-forward control is …… than feedback control.

a) moderate b) slower

c) fasterd) none of these.

vi) If the proportional band of a electronic PID controller is set at 10 then what is the proportional gain ?

a) 1

b) 10

c) 100

d) depends on the resistance values.

vii) For slurries and highly viscous fluids, which of the following types of valve is suitable ?

a) Butterfly valve b) Globe valve

c) Saunder valve d) None of these.

viii) The steady-state error of a plant with controller having transfer function, $G_c(s) = 2\left(1 + \frac{1}{2s}\right)$ will be

a) zero

b) 2 times the change in set-point or load

c) half the change in set-point or load

d) not determinable.

ix) DDC is a type of which control scheme ?

a) analog control b) multi variable

c) ratio control d) feed-forwar. ☐

x) Spring diaphragm actuator non-linearity is overcome by the use of

a) I/P converter b) positioners

c) solenoid valves d) air pressure regulator. ☐

xi) Cohen-Coon controller tuning technique is used for

a) open loop system b) closed loop system

c) both of these d) none of these. ☐

xii) Resolution of DAC using fractional number is

a) V = Vr.2 – n b) Vr/2 – n

c) Vr2n d) 2n Vr/n + 1. ☐

GROUP – B

(Short Answer Type Questions)

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

2. a) Why is the proportional gain K_p for *PI* control is less than the value for *P*-only control that is derived by Ziegler-Nichols technique ?

b) Why is K_p for PID control more than that of PI obtained by the same method ?

c) Why is *PI* controller recommended for controlling flow rate than PID controller ?

$1\frac{1}{2} + 1\frac{1}{2} + 2$

3. Explain with a neat sketch how feed-forward control is implemented for temperature control in a heat exchanger system. 5

4. Refer Fig 1 and find out the time period of oscillation of the water level in the tank under on-off control.

(Assume zero lag)

Process data :

Inflow rate Q_{in} = 3 m^3 /min

Outflow rate Q_{out} = 5 m^3 /min

Tank diameter = 10 metre

Differential Gap of the

High Level Switch (LSH) = 200 mm.

Dia.

5

5. The transfer function of a PID controller is given as $G_c(s) = \frac{1}{6s}(15s^2 + 30s + 20)$.

Find the proportional gain, reset time and the rate time of the controller. 5

6. How is proportional action realized in pneumatic controllers ? How can the gain of the controller be changed ? 4 + 1

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. a) Explain the principle of operation of ON-OFF controller. 2

b) What is the effect of differential gap or neutral zone on the performance of ON-OFF controller ? 2

c) A liquid level control system linearly converts a displacement of 2 to 3 metre into a 4-20 mA control signal. A relay serves as a two position controller to open or close an inlet valve. The relay closes at 12 mA and opens at 10 mA.

Find :

i) The relation between the displacement and current

ii) The neutral zone in metre. 4

d) Why derivative control action cannot be used alone ? 2

e) A PI controller is used to control the pressure in a tank which varies from 40 psi to 140 psi. Desired pressure is 90 psi. Controller output is to changed by 100% upon 40 psi pressure deviation. Reset rate is 1/5 repeats per minute and controller output at zero error is 50%. Calculate the controller output at the end of 2 minute when pressure in the tank becomes 80 psi. 5

8. a) Draw the block diagram of a typical feedback process control loop and describe the function of each block in brief. 5

b) Define process resistance and process capacitance. 2

c) Find out the overall transfer function of the cascaded tank system as shown in the diagram below. All the symbols have their usual meanings. 8

dia.

9. a) What do you mean by tuning of controllers ? What is $\frac{1}{4}$ th decay ratio ? 2 + 2

b) What are the different methods of tuning of controllers ? 2

c) What is process reaction curve ? How is it obtained ? Sketch the S-curve and show the parameters which are used for controller tuning. 1 + 2 + 2

d) In the Ziegler-Nichols method, the critical gain was found to be 4.2, and the critical period was 2.21 min. Find the standard setting for PID control. 4

10. a) Define C_V factor / valve sizing and draw the valve characteristics. 5

b) How is valve selection made ? 3

c) What is cavitation ? 2

d) A 1.5 inch control valve has the following specifications :

At 30% valve opening, C_V = 0·9 ; at 40% valve opening C_V = 1·5, and at 80% valve opening, C_V = 9·25. Calculate C_V at 90% valve opening when the control valve has equal per cent characteristics. 5

9

11. Write short notes on any *three* of the following : 3 ∞ 5

a) Multi-variable control

b) Boiler drum level control

c) DDC

d) Override control

e) Electrical actuators.

END