PROCESS CONTROL (SEMESTER - 6)

CS/B.TECH (EIE-O)/SEM-6/EI-601/09

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ENGINEERING & MANAGEMENT EXAMINATIONS, JUNE – 2009
PROCESS CONTROL (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 **32 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.

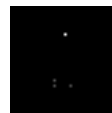### No additional sheets are to be used and no loose paper will be provided

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GROUP – A
(Multiple Choice Type Questions)

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

    i)   Which controller is a discontinuous mode of operation ?

         a)   P   b)   PI

         c)   ON-OFF   d)   PD.

    ii) Proportional gain is higher in

         a)   Ziegler-Nichols method   b)   Cohen-Coon method

         c)   both of these   d)   none of these.

    iii) For a 100% error to the P controller, its output is 50%. The proportional band PB
         is

         a)   200%   b)   150%

         c)   50%   d)   100%.

    iv) Controller that cannot be used alone

         a)   I controller   b)   D controller

         c)   P controller   d)   PID controller.

    v)   Circuit gain of electronic I controller is

         a) $G_I = 1/RC$ b) $G_I = 1/R$

         c) $G_I = 1/C$ d) $G_I = 1/Z$.

vi)   Which valve is most commonly used for throttling service ?

     a)   Globe valve   b)   Needle valve

     c)   Ball valve   d)   Gate valve.

vii)   In pneumatic spring actuator type control valves, non-linearities are counteracted by

     a)   positioner   b)   current to pressure converter

     c)   air filter regulator   d)   safety valve.

viii)   The feedback system is unsatisfactory for

     a)   fast process   b)   sluggish process

     c)   any one of the processes   d)   none of these.

ix)   Bevelled type valve is used for

     a)   decreasing sensitivity   b)   increasing sensitivity

     c)   linear sensitivity   d)   all of these.

x)   If K_C denotes the proportional gain, T_1 is the integral time of a PID controller then the reset time T_r is given by

     a) $1/K_C T_1$ b) $K_C T_1$

     c) K_C / T_1 d) T_1 / K_C.

xi)   The hydraulic controllers have

     a)   very low inertia/torque ratio   b)   very low power gain

     c)   very high inertia/torque ratio   d)   very high power gain.

xii)   Ratio control system is a special type of

     a)   open loop control   b)   on-off system

     c)   feed forward system   d)   feedback system.

xiii)   Which of the following control schemes is known as anticipatory control ?

    a)   Feedback control

    b)   Feed-forward control

    c)   Cascade control

    d)   All of these.

xiv)   For calculation of controllability .... type disturbance is considered.

    a)   ramp input

    b)   step input

   c)   parabolic input

    d)   impulse input.

GROUP – B

### (Short Answer Type Questions)

Answer any *three* of the following questions.   3 × 5 = 15
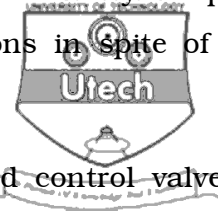
2.   What is Multivariable control ? Give an example of a Multivariable control used in a process.   1 + 4

3.   Explain the following terms :

Process lag, Proportional band and Rangeability of a control valve.   5

4.   Explain, with the schematic diagram, the operation of an On-Off controller.   5

5.   What is servo loop ? Explain it with a proper diagram. How does it differ from a process control loop ?   1 + 3 + 1

6.   What is Reset action ? Prove that $P.B = 100/K_c$, where symbols have their usual meaning.   1+ 4
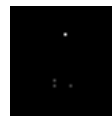
GROUP – C

(Long Answer Type Questions)
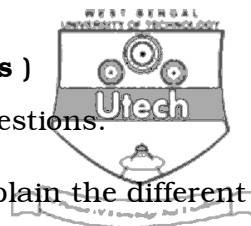
Answer any *three* of the following questions.   3 × 15 = 45

7. a) Write down the equation of a PI controller and explain the different terms used. 5

    b) Sketch an electronic PI controller using a single OP-AMP and derive the expression for controller output.   7

    c) What are the limitations of PD controller ?   3

8. a) Draw the basic block diagram of a process control loop and explain the blocks in it.   3 + 4

    b) Realize a *P*-controller by using pneumatic method.   5

    c) Explain the operating principle of a Flapper-Nozzle system.   3

9. a) What do you mean by "offset" in proportional control action ? What are the different ways to remove it ?   3

    b) Explain hydraulic proportional controller with suitable diagram.   5

    c) Explain the fuel-air ratio control technique in combustion control.   7

10. a) Explain the method of tuning of a controller using a process reaction curve.   4

    b) Design an electronic PI controller with Proportional gain = 4, Reset time = 10 secs.   4

    c) Study the process shown below and find out its transfer function. What kind of a process is it ? Does such a process possess self regulation ? Justify.   3 + 1 + 3
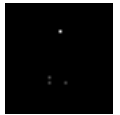
11. a) Show the different types of control valve characteristics. Why is equal percentage valve mostly preferred in process control operations in spite of its non-linear nature ?

    b) What is the problem associated with single seated control valves ? How is it eliminated in double seated valves.

    c) What is the difference between safety valve and solenoid valve ?

    d) What is valve coefficient of a control valve ?

    e) What is positioner of a control valve ? Describe its operation with a suitable diagram.   (2 + 2) + (1 + 2) + 2 + 2 + (1 + 3)

12. a) Draw the block diagram of a direct digital control loop. Explain the different blocks in it.

    b) Explain the working principle of a three element Drum level control system.   7 + 8

END