Name : ....

Roll No. : ....

Invigilator's Signature : ....

CS/B.TECH (ICE)/SEM-6/IC-601/2012

2012
PROCESS CONTROL

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.*

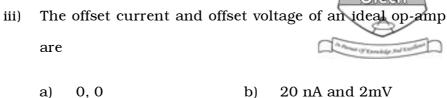## GROUP – A
(Multiple Choice Type Questions)

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

$10 \times 1 = 10$

   i)   The function of reset action in process control is to

   a)   reduce rise time

   b)   reduce steady state error

   c)   reduce oscillation in the response

   d)   increase the overall gain.

   ii)   Butterfly valve is

   a)   sliding stem type

   b)   movable stem type

   c)   both sliding and movable type

   d)   none of these.

iii) The offset current and offset voltage of an ideal op-amp are
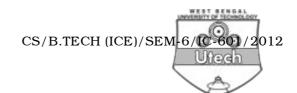
a) 0, 0

b) 20 nA and 2mV

c) ∞, ∞

d) 20 mA and 2 mV.

iv) In a flapper-nozzle mechanism, if flapper moves closer to the nozzle, the nozzle back pressure will

a) decrease

b) increase

c) remain constant

d) depend upon the construction.

v) Rangeability is defined by

a) $\dfrac{Q_{max}}{Q_{min}}$

b) $\dfrac{\Delta P_{max}}{\Delta P_{min}}$

c) $\dfrac{C_{V_{max}}}{C_{V_{min}}}$

d) $\dfrac{\Delta P_{max}}{\Delta Q_{max}}$.

vi) Which of the following is not a part of the final control element ?

a) Actuator

b) Controller

c) Control valve

d) All of these.

vii) In pneumatic system, electrical capacitance is analogous to

    a) resistance to flow   b) volume of air

    c) filled helical tube   d) none of these.

viii) For satisfactory control of gas pressure, the control action should be

    a) ON-OFF control mode

    b) proportional control mode

    c) integral control mode

    d) PID control mode.

ix) Cohen-Coon's tuning rule is used for

    a) open loop system

    b) closed loop system

    c) both open and closed loop system

    d) none of these.

x) Which of the following is not a popular serial interface standard ?

a) RS-422   b) RS-423

c) RS-455   d) RS-485.

xi) Which of the following is not a category of control valves ?

a) Fast opening   b) Linear

c) Equal percentage   d) Bumpless.

xii) A non-interacting system is always

a) overdamped system

b) critically damped system

c) both overdamped and critically damped system

d) only underdamped system.

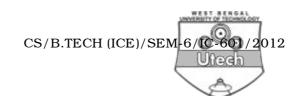### GROUP – B

(Short Answer Type Questions)

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

2. Define reverse and direct control action of controller. What is neutral zone ? What are the advantages of multi-speed floating control over single speed floating control ?   2 + 1 + 2

3. What is integral time constant ? Prove that proportional band $= \dfrac{100}{K_c}$, where the symbol has usual meaning. 2 + 3

4. A PI controller indicates an output of 12 mA when the error is zero. The set point is suddenly increased to 14mA and the controller output is recorded and given below :

Time t, sec	0	10	20	30
Output, mA	14	16	18	20

Find K_P and T_i.

5. With a neat diagram explain the operating principle of a pneumatic proportional controller.

6. How can you practically determine the installed valve characteristic of a control valve in an installation ? Give the reasons for determining the installed characteristic.

GROUP – C

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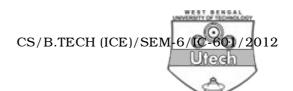
Answer any *three* of the following. 3 × 15 = 45

7. a) Describe the importance of three well known time integral performance criteria, ISE, IAE and ITAE. How can you choose the most appropriate criterion for a particular operation ? 5

b) What are the situations under which an ON/OFF controller would provide satisfactory performance ? 5

c) Design a PI controller with proportional band of 30% and an integration time of 10 sec. The 4-20 mA input converts into 0-2V error signal. The output is to be in between 0 and 10 V. 5

8. a) In the context of time delay system schemes, explain in detail how Smith's controller can be employed. 7

b) What are self-regulating and non-self-regulating processes ? Explain each of them with one example. 5

c) Differentiate between "log" and "delay". 3

9. a) Define turn-down of a control valve. Explain the cavitations and flashing phenomena of a control valve with the help of diagram. 5

b) Differentiate between erosion and corrosion phenomena in control valves. What are the advantages and disadvantages of a double-seated control valve ? 2 + 3

c) A heating furnace requires a control valve passing 10 gpm preheated light fuel oil ($S_g = 0 \cdot 5$) at full load and only 0·2 gpm at the smallest load. The pressure differential at wide open is 20 psi. Calculate (a) C_V; (b) K_V. 5

10. a) What are composite control modes ? Name three composite control modes. 4

b) Explain in detail how can ultimate cycle method be employed for controller tuning. 5

c) How does Schmitt trigger help in reducing the effect of noise on switching in a process control system ? 4

d) What is "degree of freedom" of process ? 2

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

a) Pneumatic relay

b) Electronic error detector

c) Feed forward control

d) Valve positioner

e) Electro-pneumatic converter.

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