Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.TECH(BT)/SEM-6/CHE-615/2012

2012
PROCESS INSTRUMENTATION AND 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) In measurement systems, which of the following static characteristics are disirable ?

      a) Accuracy b) Sensitivity

      c) Reproducibility d) All of these.

   ii) Which of the following are the desirable dynamic characteristics of measurement system ?

      a) Fast response, fidelity, measuring lag and dynamic error

      b) Fast response and measuring lag

      c) Fidelity and measuring lag

      d) Fast response and fidelity.

iii) The damping co-efficient in a critically damped system is

a) > 1 b) < 1

c) = 1 d) zero.

iv) The Laplace transformation of unit step function is

a) 1 b) 1/s

c) s d) None of these.

v) Which of the following instruments is an area type flow meter ?

a) Venturimeter b) Pitot tube

c) Rotameter d) Orifice meter.

vi) A system will be stable if

a) All the roots of the characteristic equation have the positive real part

b) All the roots of the characteristic equation have the negative real part

c) Some roots have positive real parts and remaining roots have the negative real parts

d) All roots are on the imaginary axis.

vii) Dead weight tester is used for

a) Testing dead weight

b) Measuring the process pressure accuracy

c) Producing the high pressure

d) Calibrating the pressure instruments.

viii) PSIG stands for

a) pascal per square inch, gauge

b) pound per square inch, gauge

c) poundal per square inch, gauge

d) poundal per square inch, gravitational.

ix) Thermistor is used to measure

a) temperature

b) pressure

c) volumetric flow rate

d) velocity.

x) Bourdon tube is used to measure

a) Pressure difference b) Temperature difference

c) acceleration d) liquid leve difference.

xi) The material having highest value of gauge factor is

a) Ni b) Fe

c) Ag d) Pt.

xii) Among the following which one measures liquid velocity at a particular point of flow line ?

a) Venturimeter b) Orifice meter

c) Pitot tube d) Rotameter.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. Compare different temperature measuring devices with reference to range and applicability.

3. What is LVDT ? What are its range and sensitivity ? What do you mean by residual voltage w.r.t. LVDT ? $2 + 1\frac{1}{2} + 1\frac{1}{2}$

4. a) Define valve co-efficient

   b) What are the selection criteria of control valve ?

   c) What is cavitation ? $1\frac{1}{2} + 2 + 1\frac{1}{2}$

5. Describe the Ziegler-Nichols closed loop tuning procedure.

6. What are block diagram and time constant ?

7. A unity feedback system has an open loop transfer function $G(s) = \frac{10}{s(s+2)}$. In this system if two poles are introduced in open loop at $\pm j\sqrt{3}$, predict the stability of the closed loop system.

GROUP – C

(Long Answer Type Questions)

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

8. Draw a neat sketch of a Bourdon Tube. State the materials of construction of Bourdon Tube. How would you define normalized sensitivity of Bourdon Tube and on what factor does it depend ? Name one material which has negative temperature coefficient of resistance. What are the advantages of magnetic flowmeter ? What is anemometer ?

6 + 2 + 2 + 1 + 2 + 2

9. Compare venturimeter and orifice meter. What is thermopile ? What are pyrometers ? Give one example of application of pyrometer. How do you derive gauge factor expression ? Justify that the expression contains only constant quantity. Give examples of construction materials for thermocouple fabrication. Draw a scheme for measuring liquid leve in a tank with digital display (output).

3 + 2 + 3 + 3 + 1 + 3

10. a) The open loop transfer function of a unity feedback control system is given by

$$G(s) = \frac{K}{s(s+1)(s+2)}$$

i) Determine the number of branches of root loci.

ii) Find the centroid & angle of asymptotes.

iii) Find the break away point.

iv) Find the frequency of sustained oscillation.

Hence the root locus of the system.

b) Define absolute stability & relative stability

1 + 2 + 2 + 2 + 4 + 2 + 2

11. a) Plot the Bode diagram for the system of which open loop transfer function is

$$G(s) = \frac{K}{(s+1)(s+5)}$$

b) Define Gain crossover frequency & Phase crossover frequency. 10 + 5

12. a) Define proportional band.

b) State why PD control action referred as anticipatory control.

c) What is offset ? Explain how the offset is used to reduce or eliminate from the process control loop.

d) Explain how control is achieved in the following processes (any one) :

i) Heat exchanger

ii) Distrillation column. 2 + 2 + 7 + 1 + 3

13. Derive proportional, Proportional-Integral and Derivative controllers.