



Name :

Roll No. :

Invigilator's Signature :

CS/B.Tech (BT-NEW)/SEM-6/CHE-615/2010

2010

PROCESS INSTRUMENTATION & 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) Macleod gauge is used to measure
- a) pressure b) vacuum
- c) flow rate d) temperature.
- ii) The transfer operation of the first order system is
- a) $1/T_s + 1$
- b) $1/T_s$
- c) $S/T_s + 1$
- d) None of these.



iii) Which of the following is not a mechanical pressure sensing element ?

- a) U-tube b) Burdon tube
- c) Diaphragm d) Bellons.

iv) Error caused by the act of measurement on the physical system being tested is

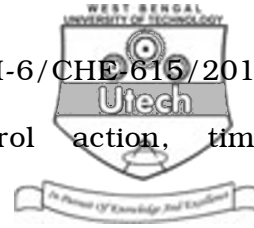
- a) Hysteresis error b) Random error
- c) Systematic error d) Loading error.

v) Optical pyrometer is used to measure the temperature of

- a) furnace
- b) low temperature
- c) moderate temperature
- d) liquid.

vi) Ratio control system is a special type of

- a) open loop system
- b) feedback system
- c) on-off system
- d) feed forward system.



vii) In proportional-plus-integral control action, time required for oscillations to stop is

- a) larger
- b) considerable
- c) shortest
- d) none of these.

viii) The Laplace transform of $\sin t$ is

- a) $1/S^2 + 1$
- b) $S/S^2 + 1$
- c) $1/S^2 - 1$
- d) $S/S^2 - 1$.

ix) The frequency at which the maximum amplitude ratio is attained is known as

- a) resonant frequency
- b) radian frequency
- c) corner frequency
- d) cross-over frequency.

x) Which has maximum offset in P , $P - I$, $P - D$, PID controller ?

- a) P
- b) PID
- c) PD
- d) PI .



xi) Repeatability of the instrument with respect to a given fixed input is

- a) accuracy b) precision
- c) systematic error d) loading error.

xii) Critically damped system means damping coefficient is

- a) 1 b) > 1
- c) < 1 d) 0.

GROUP – B

(Short Answer Type Questions)

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

2. Derive the transfer function of a first order system. 5

3. A step change of magnitude 4 is introduced into a system

having transfer function

$$\frac{Y(s)}{X(s)} = \frac{1}{s^2 + 1.6s + 4}$$

Determine overshoot, decay ratio and period of oscillation. 5

4. Write down the operating principle of resistance thermometer. 5



5. Calculate C/R for the following control loop :

5

6. What are cascade control & adaptive control ?

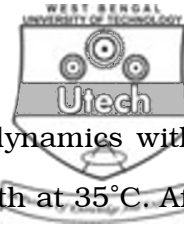
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GROUP – C

(Long Answer Type Questions)

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

7. a) Explain the working principle of gas chromatography and polarography with suitable diagram.
- b) Explain Seebeck, Peltier and Thomson effects. Define a thermocouple and explain how it generates *e.m.f.* 7 + 8
8. a) Describe the behaviour of a typical feedback control system using different kinds of control action when it is subject to a permanent disturbance with sketch.



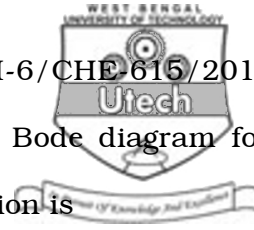
- b) A Hg thermometer having a 1st order dynamics with a time constant of 60 sec is placed in a bath at 35°C. After the thermometer reaches a steady state it is suddenly placed in a bath at 40° C at $t = 0$ and left there for 60 sec after which it is immediately return to the bath at 35° C.

- i) Calculate the thermometer reading at time $t = 30$ sec & 120 sec.
- ii) Draw a sketch showing the variation of thermometer with time.
- iii) What would be the reading at $t = 6$ sec if the thermometer had only been immersed in 40°C bath for less than 1 sec before being returned to 35° C bath.

5 + 10

9. a) Define proportional band.
- b) Describe ON-OFF control.
- c) Analyse the stability of the system having the following characteristic equation :
- $$3s^4 + 10s^3 + 5s^2 + 5s + 2 = 0$$
- d) State why PD control action referred as anticipatory control.

1 + 2 + 10 + 2



10. State the Bode stability criteria. Plot the Bode diagram for the system whose open loop transfer function is

$$G_s = \frac{1}{(s+1)(s+5)} \quad 15$$

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

- a) Static characteristics of instruments
 - b) PID controller
 - c) Static & Dynamic errors
 - d) Digital & Analog controller.
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