

GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER-VI • EXAMINATION – SUMMER • 2014

Subject Code: 160404**Date: 28-05-2014****Subject Name: Instrumentation and Process Control****Time: 10:30 am - 01:00 pm****Total Marks: 70****Instructions:**

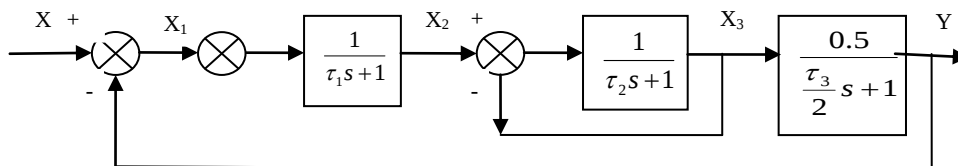
1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1 (a)** Define and Explain 07
- | | |
|-------------------------|---------------------------------|
| 1) Manipulated variable | 4) Servo & Regulator control |
| 2) Controlled variable | 5) Positive & Negative feedback |
| 3) Load variable | 6) Transfer function |
| | 7) Time Constant |
- (b)** The temperature of the contents of CSTR is measured with a thermometer having a time constant of 10 seconds. The heat supply to the CSTR changes such that its temperature changes from 100°C to 110°C at a steady rate of 20°C/minute and maintain at this value thereafter. Obtain and plot response of the thermometer. 07

- Q.2 (a)** Find the inverse of the following functions. 07
- 1) $f(s) = \frac{1}{\tau s + 1}$ 2) $f(s) = \frac{1}{s(\tau_1 s + 1)(\tau_2 s + 1)}$ 3) $f(s) = \frac{1}{s(\tau s + 1)^2}$
- 4) Prove $L\{\delta(t)\} = 1$
- (b)**
- 1) Derive transfer function of a liquid level tank pure capacitance. Also, find the level in the tank as a function of time when there is a unit step change in the flow-rate. 04
- 2) Explain advantages and disadvantages of higher gain K_C . 03

OR

- (b)** Find $\frac{Y}{X}$ 07



- Q.3 (a)** Merits and Demerits of 07
- 1) ON-OFF controller 2) P controller 3) PID controller
- (b)** 1) A proportional controller is used to control temperature within the range of 70°C to 100°C. The controller is adjusted so that the output pressure goes from 3 Psi to 15 Psi as the measured temperature goes from 72° to 75°C, with the set point held constant. Find the gain and proportional band. 04
- 2) Define and explain the Offset. 03

OR

- Q.3 (a)** A control system has time constants of 1.5 minute and 2 minute and a P – controller. Obtain the response of the closed loop for a unit step change in the set point, and controller gain that gives a damping ratio of 0.5. 07
- (b)** Write short notes on parts of the instruments with neat figure. 07

- Q.4 (a)** Write short notes on Bi-metallic thermometer, with neat figure. **07**
(b) Derive the response of a first order system if a disturbance is given the form of sinusoidal input. **07**

OR

- Q.4 (a)** Derive the transfer function of U-tube manometer, and explain the importance of damping parameter. **07**

- Q.4 (b)** Explain with neat figure the bubbler system for the level measurement. **07**

- Q.5 (a)** Define stability of the system. A PD controller having the derivative time $\tau_D=4$ used to control two non interacting first order system having time constant $\tau_1 = 1$ and $\tau_2=0.5$. The gain of system is 0.5. Determine the stability of the control system. Use Routh criterion. Assume unit feedback control system. **07**

- (b)** A proportional controller is used to control two non-interacting first order system having time constant $\tau_1 = 1$ and $\tau_2=0.5$. Sketch the root locus diagram. Assume unit feedback control system. **07**

OR

- Q.5 (a)** 1) A unit step change is introduced into a PID controller if $K_C = 10$, $\tau_I = 1$, $\tau_D = 0.5$. Obtain the response of controller $P(t)$. **04**

- 2) Explain with a neat sketch importance of transfer function. **03**

- (b)** Enlist different pressure measuring instrument. Explain in detail Bellows pressure gauge for the pressure measurement. **07**
