Seat No.: _____ Enrolment No._____

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
2) Controlled variable
3) Load variable
4) Servo & Regulator control
5) Positive & Negative feedback
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 valve 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{δ (t)} = 1

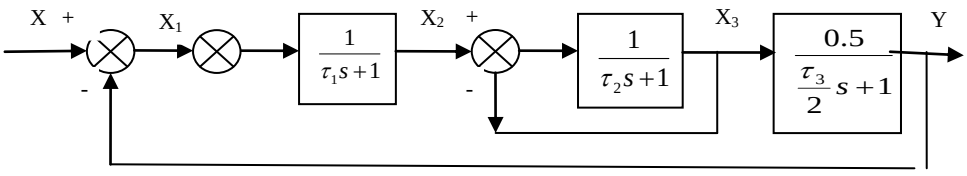
(b)

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 τ_D=4 used to control two non interacting first order system having time constant τ_1 = 1 and τ_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 τ_1 = 1 and τ_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, τ_I = 1, τ_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**

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