

**GUJARAT TECHNOLOGICAL UNIVERSITY****BE - SEMESTER-V (NEW) EXAMINATION – SUMMER 2019****Subject Code: 2150504****Date: 03/06/2019****Subject Name: Instrumentation & Process Control****Time: 02:30 PM TO 05:00 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) Why P mode controller creates offset? How can it be overcome? **03**  
(b) Define the following terms: **04**
- i. Overshoot
  - ii. Response time
  - iii. Rise time
  - iv. stability of the process
- (c) A thermometer with time constant 10 sec showing a steady temperature of 35 °C is suddenly immersed in heated oil bath at 200 °C. Find: **07**
- i. Time required for temperature reading of 150 °C.
  - ii. Temperature reading on the thermometer after 25 sec.
  - iii. The percentage response after 40 sec.

- Q.2** (a) List out the assumptions for mercury thermometer as first order system and justify them. **03**  
(b) Prove that the effect of feedback is to speed up the response of the control. **04**  
(c) Define second order system. Derive the transfer function of U-Tube Manometer in which pressure P is acting in one limb and other limb is open to the atmosphere. **07**

**OR**

- (c) For two interacting first order liquid level systems derive the transfer function. Show the effect at outlet flow rate from second tank to step and pulse input disturbance in flow to the first tank. **07**
- Q.3** (a) What is offset? Why it cannot be eliminated when P-controller is used? **03**  
(b) Explain transfer lag and transportation lag. **04**  
(c) The transfer function of the second order control system is given as, **07**

$$G(s) = \frac{5}{2s^2 - 1.63s + 5}$$

A step change of magnitude 5 is given in the input variable. Determine,

- 1) Overshoot
- 2) Rise time
- 3) Period of oscillation
- 4) Maximum value of response

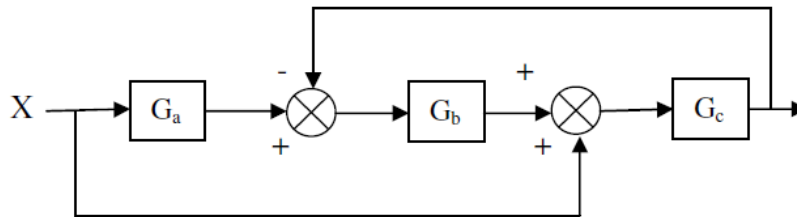
**OR**

- Q.3** (a) Solve the following by using Laplace transforms: **03**
- $$\frac{d^2y}{dx^2} + 4x = 2e^{-t}; \text{ given } x(0) = x'(0) = 0.$$
- (b) Draw the block diagram for temperature control system of heated stirred tank with proportional controller. **04**  
(c) What are Bode diagrams? Explain the graphical rules for Bode diagrams. **07**

- Q.4 (a) Prove that  $L\{\delta(t)\} = 1$  www.FirstRanker.com 03  
 (b) Explain rules of Root-Locus diagram. 04  
 (c) A proportional derivative controller having the gain  $K_c$  and the derivative time is 4 is used to controller two first order non-interacting systems having time constant  $\tau_1=1$  and  $\tau_2=0.5$ . If the gain of the process is 0.5. Sketch the Root locus diagram for the control system. The transfer function of the measuring element is  $1/S$ . 07

**OR**

- Q.4 (a) Explain Servo and Regulator control with suitable examples. 03  
 (b) What do you mean by open loop transfer function and closed loop transfer function? Determine the transfer function  $Y(s) / X(s)$  for the following block diagram. 04



- (c) Determine the stability of the system having the open loop transfer function given as, 07

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

Use Routh criterion. Determine the value of gain of the controller for which the system just causes instability.

- Q.5 (a) Define following terms: 03  
 i. Static error  
 ii. Drift  
 iii. Reproducibility  
 (b) Explain principle and working of venturimeter. 04  
 (c) Describe the bubbler system for liquid level measurement with neat sketch. 07

**OR**

- Q.5 (a) Mention various temperature measurement methods. 03  
 (b) Explain dynamic characteristics of an instrument. 04  
 (c) Describe the principle, construction and working of thermocouple used for temperature measurement. 07

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