Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V (NEW) - EXAMINATION – SUMMER 2017

Subject Code: 2150504 **Date: 03/05/2017**

Subject Name: Insrumentation & 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 Answer the following Questions. **14**

1 Write Laplace transform of exponential function $f(t) = e^{-at}$ for $t \geq 0$

2 What is first order system?

3 Interacting capacities are more sluggish than noninteracting. True or False?

4 Write any two rules for block diagram reduction.

5 Proportional controller with a gain Kc is used to control first order process. If we increase Kc than what will happen to offset?

6 Write down transfer function of PID controller.

7 Define: Dynamic error

8 State the relation between absolute pressure and gauge pressure.

9 Define: Decay Ratio

10 Write down advantages of pyrometer over other temperature sensors.

11 Write down four different units of pressure.

12 When you will employ differential pressure method for level measurement?

13 Write down application of Pitot tube.

14 What is basic difference between variable head flow meter and variable area flow meter?

Q.2 (a) A system has a transfer function $\frac{Y}{X} = \frac{10}{s^2 + 1.6s + 4}$. A step change of 4 unit's magnitude is introduced in this system. Calculate the percentage overshoot. **03**

(b) Briefly describe the initial value theorem and final value theorem. **04**

(c) Laplace Transform of the function x(t) is given by **07**

$$\bar{x}(s) = \frac{s^2 - s - 6}{(s-1)(s+1)(s-2)}$$

Find the inverse Laplace Transform.

OR

(c) Prove that Laplace transform of derivative, $L\left[\frac{df(t)}{dt}\right] = s\,\bar{f}(s) - f(0)$ where, $\bar{f}(s) = L\left[f(t)\right]$ and then solve $\frac{dx}{dt} + 2x = 0$ using Laplace Transform, subject to initial condition $x(0) = 4$ **07**

Q.3 (a) Derive transfer function of pure capacitive process. **03**

(b) With neat sketch briefly explain air-to-open and air-to-close pneumatic control valves. **04**

(c) Derive the transfer function of first order lag system and discuss its dynamic response. **07**

OR

Q.3 **(a)** Noninteracting capacities never result in an under damped second order system. True or False? Explain **03**

(b) Differentiate between Servo problem and Regulator problem **04**

(c) Describe the characteristics of underdamped response. **07**

Q.4 **(a)** Discuss the effect of gain (Kc) on closed-loop response of second order systems with proportional control. **03**

(b) Describe the construction and working of rotameter. **04**

(c) Obtain the transfer function C(s)/R(s) for the block diagram shown in figure 1. **07**

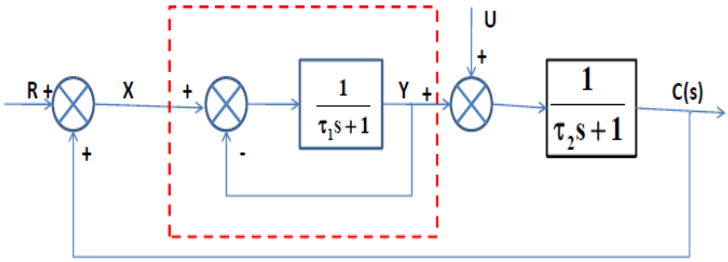

Figure 1: Block diagram to be reduced

OR

Q.4 **(a)** State the importance of level measurement and control in various processes. **03**

(b) For characteristics equation given below, do the stability analysis using Routh criteria. **04**

$$s^3 + 2s^2 + (2 + K_C)s + \frac{K_C}{\tau_I} = 0$$

(c) Do Route Locus analysis for two capacities in series with proportional control. **07**

Transfer function, $G_P(s) = \dfrac{K_P}{(\tau_1 s + 1)(\tau_2 s + 1)}$

Q.5 **(a)** Describe classification of instruments. **03**

(b) List the various pressure measuring instruments. Describe construction and working of barometer. **04**

(c) Plot the bode diagram for the system whose overall transfer function is $\dfrac{1}{(s+1)(s+5)}$ **07**

OR

Q.5 **(a)** Briefly describe the selection procedure for different components of thermocouple. **03**

(b) List various variable head flow meters and explain any one. **04**

(c) Describe the construction and working of radiation pyrometer. **07**

****