

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER- V EXAMINATION – SUMMER 2020

Subject Code: 2150504

Date: 02/11/2020

Subject Name: INSTRUMENTATION & PROCESS CONTROL

Time: 02:30 PM TO 05:00 PM

Total Marks: 70

Instructions:

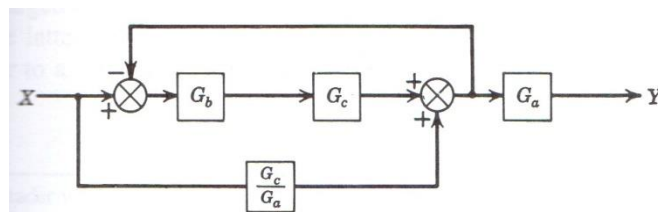
1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

		MARKS
Q.1	(a) Distinguish among step, exponential, sine and ramp forcing functions.	03
	(b) Discuss the comprehensive comparison of time constant of first order systems: Mercury thermometer, liquid level in single tank & mixing process.	04
	(c) Prove that “Response of Noninteracting tanks always result in an overdamped or critically damped second-order system and never in an underdamped system”	07
Q.2	(a) Compare the step response and nature of roots of second order system.	03
	(b) With Inversion by partial fractions prove that $\frac{dX}{dt} + X = 1$	04
	(c) A step change of magnitude 4 is introduced into a system having the transfer function $\frac{Y(s)}{X(s)} = \frac{10}{s^2 + 1.6s + 4}$	07
	Determine (a) Percent overshoot (b) Rise time (c) Maximum value of Y(t) (d) Ultimate value of Y(t) (e) Period of oscillation	
	OR	
	(c) A thermometer having a time constant of 0.2 min is placed in a temperature bath, and after the thermometer comes to equilibrium with the bath, the temperature of the bath is increased linearly with time at a rate of 1°/min. What is the difference between the indicated temperature and the bath temperature (a) 0.1 min (b) 1.0 min after the change in temperature begins?	07
Q.3	(a) Discuss the rules for convert close loop block diagram into single transfer function.	03
	(b) Derive the transfer function of distance velocity lag.	04

- (c) Derive the transfer function of second order U tube manometer & step response for critically damped. **07**

OR

- Q.3** (a) Differentiate between Negative Feedback and Positive Feedback with suitable examples of each. **03**
(b) Differentiate between Servomechanism type problem and Regulator problem. **04**
(c) Determine the transfer function $Y(s)/X(s)$ for the block diagram shown in Fig. **07**



- Q.4** (a) Derive the transfer function of PI control. **03**
(b) Discuss the advantages and disadvantages for P, PI & PID control for feedback control system. **04**
(c) The open loop transfer function of a certain control system is defined as **07**

$$G(s) = \frac{K_c}{(s+1) \left[\left(\frac{s}{2} \right) + 1 \right] \left[\left(\frac{s}{3} \right) + 1 \right]}$$

Determine the value of K_c for which the control system is stable by using Routh test for stability. And For the value of K_c for which the system is on the threshold of instability, determine the roots of the characteristic equation with the help of routh test theorem 3.

OR

- Q.4** (a) Derive the transfer function of PID control. **03**
(b) Explain linear system versus non-linear system. **04**
(c) Explain Nyquist stability criteria. **07**

- Q.5** (a) Discuss the principal of measurement in Bimetallic Thermometer. **03**
(b) Discuss the various elements of an Instrument. **04**
(c) Explain the principal, construction and working of radiation pyrometer. **07**

OR

- Q.5** (a) Discuss the principal of liquid level measurement in bubbler system. **03**
(b) Discuss the various types of pressure springs which used in thermometer. **04**
(c) Explain the principal, construction and working of bellows differential-pressure gauge. **07**
