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

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code: 2160407 **Date: 03/05/2017**

Subject Name: Instrumentation and Control for Bioengineering

Time: 10:30 AM to 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.**

			MARKS
Q.1		**Short Questions**	
	1	In which temperature range an industrial mercury-in-glass thermometer can be used?	**01**
	2	Explain the function of pyrometer.	**01**
	3	What is the significance of an inclined tube manometer?	**01**
	4	Define an Air-to-Open control valve.	**01**
	5	Write transfer function of transportation lag.	**01**
	6	Define Gain Margin and Phase Margin.	**02**
	7	Write different components of a block diagram.	**01**
	8	Give two examples of variable head meters.	**01**
	9	Which instrument is used for measuring stack gas velocity?	**01**
	10	What is offset of a PI-Controller?	**01**
	11	Write Bode stability criterion.	**02**
	12	Define accuracy.	**01**
Q.2	**(a)**	Give mathematical equation for Initial Value Theorem and Final Value Theorem.	**03**
	(b)	Derive Laplace transform of Ramp Function.	**04**
	(c)	Solve the following differential equation by Laplace transform. $$\frac{d^3x}{dt^3}+2\frac{d^2x}{dt^2}-\frac{dx}{dt}-2x=4+e^{2t}$$ $$x(0)=1, x'(0)=0, x''=-1$$	**07**
		OR	
	(c)	Find the inverse of the following functions. a) $$f(s)=\frac{1}{s(\tau_1 s+1)(\tau_2 s+1)}$$ b) $$x(s)=\frac{1}{s(s^2-2s+5)}$$	**07**
Q.3	**(a)**	Define and explain the Time constant.	**03**
	(b)	Compare the two tank non-interacting and two tank interacting processes. Also write their transfer functions.	**04**
	(c)	Derive the transfer function for Mercury in glass thermometer clearly indicating the assumption made. What is the significance of time constant?	**07**

OR

Q.3 **(a)** What is a second order process? Write its transfer function. **03**

(b) Derive response of a first order system to a step change of magnitude M in input. **04**

(c) The transfer function of the second order control system is given as, **07**

$$G(s) = \frac{1}{0.25s^2 + 0.4s + 1}$$

Determine,

1) Overshoot 2) Period of oscillation 3) Decay Ratio

4) Rise Time

Q.4 **(a)** Define Servo and Regulator Mechanism Problem with example. **03**

(b) Find Offset of a P-Controller Servo Mechanism control system. **04**

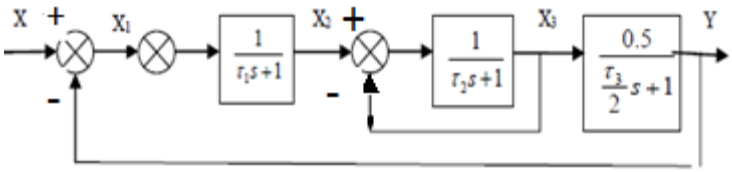
(c) Determine the value of K_C for which the control system having the open loop transfer function given below is stable. **07**

$$G(s) = \frac{K_C}{(S+1)\left(\frac{S}{2}+1\right)\left(\frac{S}{3}+1\right)}$$

OR

Q.4 **(a)** Differentiate between Negative Feedback and Positive Feedback Control Systems. **03**

(b) Find Y/X **04**



(c) The open loop transfer function of a control system is given as, **07**

$$G(s) = \frac{Kc(0.5s+1)}{s(s+1)(s+0.5)}$$

Sketch the root locus diagram of the control system. Indicate open loop poles and zeros, breakaway point, asymptotic lines, the direction in which the loci travel.

Q.5 **(a)** Define: 1) Reproducibility 2) Hysteresis 3) Dead zone **03**

(b) Explain the construction and working of bellows pressure measuring instrument. **04**

(c) Explain the working of an optical pyrometer **07**

OR

Q.5 **(a)** What is thermal well? Why is it used? **03**

(b) Explain principle and working of displacement float liquid level gage. **04**

(c) List different flow meters used in industry. Explain principle and working of Orificemeter. **07**