Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI • EXAMINATION – SUMMER • 2015

Subject Code: 160404 **Date:14/05/2015**

Subject Name: Instrumentation and process control

Time:10.30AM-01.00PM **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)** Solve following by means of Laplace Transformation : **07**

1) $\frac{d^3x}{dt^3}+3\frac{d^2x}{dt^2}+3\frac{dx}{dt}+x=1;\ x=(0)=x^{'}(0)=0$

2) $\frac{d^2x}{dt^2}+4x=2e^{-t}\ ;\quad x=(0)=x^{'}(0)=0$

(b) Derive transfer function for system mercury-in-glass thermometer and response to the sinusoidal function for the case of mercury glass thermometer. **07**

Q.2 **(a)** Two non-interacting tank operating in series at steady flow rate of 20 m^3/minute. At time t=0, 10 m^3 of water are quickly added to the first tank. Determine (i) the level in both tanks (ii) the maximum deviation in both tanks from the ultimate steady state values and the time at which each maximum occurs. **07**

Data:

$A_1=A_2=10\ m^2$

$R_1 = 0.1\ min/m^2$

$R_2 = 0.35\ min/m^2$

$q_s=q_{1s}=q_{2s} = 20\ m^3/min$

(b) Derive the transfer function of U-tube manometer and explain the importance of damping parameter. **07**

OR

(b) P-D controller is used in a control system having a 1st order process and 1st order measuring lag. **07**

i) Find the expression for τ and ϕ of the closed loop

ii) Process time constant τ_1 = 1 minute and measuring time constant τ_m = 10 sec

iii) Find the gain k_c such that ϕ = 0.7 for the 2 cases: τ_D = 0 & τ_D = 3sec

iv) Find the offset for the above 2 cases

Q.3 **(a)** A step change of magnitude 4 is introduced into a system having the transfer function, **07**

$$\frac{Y(s)}{X(s)}=\frac{10}{s^2+1.6s+4}$$

Determine the following :

(i)The response, y(t) (ii) The ultimate value, y(∞) (iii) Rise time (iv) Period of Oscillation

(b) Write short note on parts of the instruments with neat figure. **07**

OR

Q.3 **(a)** Explain any four dynamic and static characteristics of an instrument. **07**

(b) Derive the equation for Amplitude ratio and phase angle for the first order system. **07**

Q.4 **(a)** The open loop transfer function for a control system is given as **07**

$$G(s) = \frac{Kc\ (S+1)}{S(S+2)(S+3)}$$

Determine the stability of a system and find the location of pair of roots on the imaginary axis.

(b) Sketch the asymptotic Bode diagram for the following transfer function **07**

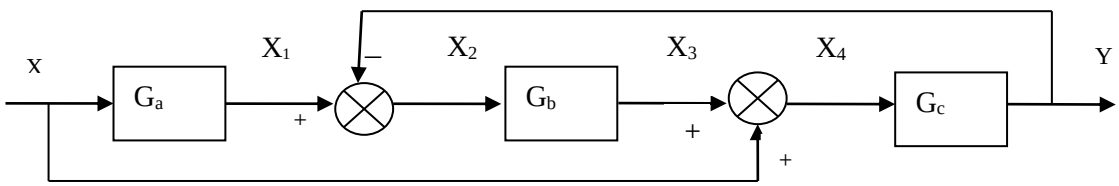
$$G(s) = \frac{Kc\ (S+1)}{S(10S+1)(0.2S+1)}$$

OR

Q.4 **(a)** What is offset? Why can it not be eliminated when P-controller is used? **07**

(b) Solve the following: **07**

Find Y/X



Q.5 **(a)** Explain Bi-metallic thermometer in detail. **07**

(b) Explain in detail the principle, construction and working of Venturi meter for the flow measurement. **07**

OR

Q.5 **(a)** Explain in detail the principle, construction and working of radiation pyrometer. **07**

(b) Describe the construction and working of the bellows pressure element with neat figure. **07**

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