

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-VI • EXAMINATION – SUMMER 2013****Subject Code: 160404****Date: 03-06-2013****Subject Name: Instrumentation and Process Control****Time: 10.30 am - 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.

Q.1 (a) 1) Solve the following function for $x(t)$ 07

$$\frac{d^2x}{dt^2} + 2\frac{dx}{dt} + 2x = 2$$

$$x(0) = x'(0) = 0$$

(b) Derive the transfer function of mercury thermometer. Determine the response equation of mercury thermometer for impulse forcing function. 07**Q.2 (a) A thermometer having a time constant of 10 second is placed in a temperature bath. After the thermometer reaches steady state temperature of 30 °C it is suddenly placed into a hot fluid at 60 °C. Sketch the response of the thermometer. 07****(b) Two interacting tanks are operating at a steady state flow rate of $4 \times 10^{-3} m^3 / \text{min}$. At time $t = 0$, the inlet flow rate to the 1st tank is suddenly increased to $14 \times 10^{-3} m^3 / \text{min}$. 07**

Data:

$$A_1 = A_2 = 0.04 m^2 \quad R_1 = 100 \text{ min}/m^2 \quad R_2 = 150 \text{ min}/m^2$$

Find the height in the level of each tank as a result of this disturbance.

OR**(b) Define and Explain the following terms 07**

- 1) Accuracy 2) Static error 3) Drift 4) Reproducibility 5) Span of an instrument 6) Dead zone 7) Sensitivity of instrument

Q.3 (a) 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

- (b) Two non-interacting tanks operating in series at a steady flow rate of $20\text{m}^3/\text{minute}$. At time $t=0$, 10m^3 of water is quickly added to the 1st tank. 07

Data:

$$A_1 = A_2 = 10\text{m}^2 \quad R_1 = 0.1\text{min/m}^2 \quad R_2 = 0.35\text{min/m}^2 \quad q_s = q_{1s} = q_{2s} = 20\text{m}^3/\text{min}$$

Determine,

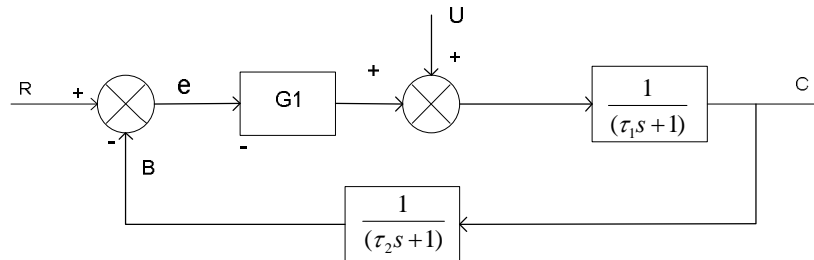
- 1) The level in both tanks

The maximum deviation in level in both tanks from the ultimate steady state values and the time at which each maximum occurs..

OR

- Q.3 (a)** Define second order system. Derive the transfer function of the damped vibrator which is oscillating on the horizontal surface. 07

- (b) Obtain the transfer function $C(s)/R(s)$ for the block diagram shown in the figure. 07



- Q.4 (a)** Starting with the principal and working, explain the construction of Bimetallic thermometer with neat sketch. 07

- (b) 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 locia travel.

OR

- Q.4 (a)** Explain the bubbler system for level measurement of liquid. State its limitations. 07

- Q.4 (b)** Write a note on Bellows differential pressure element with neat sketch. 07

- Q.5 (a)** With the help of neat sketch, describe pneumatic balance pressure thermometer. Also discuss disadvantages of it. 07

- (b) Describe orifice meter with neat figure. Also explain the methodology for determination of flow rate with equation. 07

OR

- Q.5 (a)** Draw a schematic diagram for radiation pyrometer and describe in details. 07

- (b) Write short note on the industrial thermocouple, with it working principle. 07
