Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER– V • EXAMINATION – WINTER 2016

Subject Code: 150504 Date: 17/11/2016
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 differential equation by Laplace Transform **07**

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

(b) Develop the transfer function for ordinary mercury in glass thermometer. State all the assumption involved. Also derive the equation for response to unit step forcing function. **07**

Q.2 **(a)** The open loop transfer function of a control system is given as **07**

$$G(s) = \frac{K_c}{(10s+1)^2}$$

Sketch the asymptotic bode diagram of control system.

(b) Derive the transfer function for mercury manometer as 2nd order system. **07**

OR

(b) A thermometer having first order dynamics is placed in a temperature bath of 45 ˚C. After the thermometer reaches the equilibrium with the bath. The bath temperature is subjected to sinusoidal forcing function about its average temperature of 45 ˚C with amplitude of 15 ˚C. If the period of oscillation is 30 sec/cycle and the time constant of the thermometer is 10 second. **07**
Determine the followings:
1) Maximum and minimum temperature indicated by the thermometer.
2) Amplitude ratio
3) Phase lag.

Q.3 **(a)** 1) Explain the unit impulse input and derive its Laplace transform **07**
2) Define stability of linear system. State and explain stability criterion?

(b) The open loop transfer function for the control system is given as **07**

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

Determine the value of k_C gain of controller which just caused instability by Routh array test.

OR

Q.3 **(a)** Explain servo and regulator problem with example. **07**

(b) Write short note RTD for temperature measurements. **07**

Q.4 **(a)** State various differential pressure meters to measure flow. Explain any one with neat sketch. **07**

(b) Write a short note on Direct level measurement. **07**

OR

Q.4 **(a)** Explain principle, construction & working, advantages and limitation of Diaphragm pressure gauge **07**

(b) Write in brief about Optical pyrometer. **07**

Q.5 **(a)** (1) Define and prove final value theorem. **07**

(2) Derive the transfer function for the mixing process shown in figure 1. x and y are salt concentration.

(b) Explain the characteristics of 2nd order under damped system. **07**

OR

Q.5 **(a)** Discuss the effect of K_C and τ_I on the closed loop response of the first order process with PI controller. **07**

(b) Derive the transfer function for two tanks in series in non interacting manner. Also explain the effect of interaction. **07**

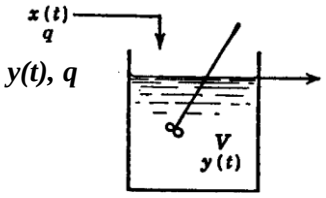

Figure 1