

GUJARAT TECHNOLOGICAL UNIVERSITY
BE SEM-VI Examination-Nov/Dec-2011

Subject code: 160404**Date: 28/11/2011****Subject Name: Instrumentation and Process Control****Time: 10.30 am -1.00 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)
- 04**

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

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

03

- 2) Invert the following function by Laplace Transform.

$$x(s) = \frac{1}{s(s^2 - 2s + 5)}$$

- (b) Define second order system. A manometer 60 cm long and 6.3 mm inside diameter glass tube is half filled with water. The manometer is subjected to a pressure differential of 3500 N/m². Determine the following: **07**

- 1) Time constant 2) Damping coefficient.

Indicate, if the manometer is suitable. Suggest design of the manometer considering the initial transient state. Take viscosity of water=1 mN-s/m² and the density of water =1000 kg/m³.

- Q.2 (a)** Derive and explain the several features of step response of first order system. **07**

- (b) Define Interacting and Non-interacting system. Derive the transfer function for non-interacting multi capacity control system in series. **07**

OR

- (b) The overall transfer function of the control system is given as, **07**

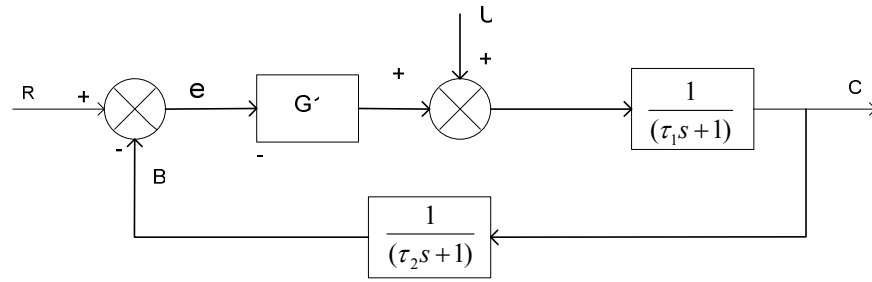
$$G(s) = \frac{16}{1.5s^2 - 2.4s + 6}$$

A step change of magnitude 6 is introduced into the system. Determine,

- 1) Overshoot 2) Period of oscillation 3) Natural period of oscillation

- 4) Rise time 5) Ultimate value of response 6) Maximum value of response

Q.3 (a) Obtain the transfer function $C(s)/R(s)$ for the block diagram shown in the figure. **07**



(b) Define Servo problem and Regulator problem. A PD controller is used to control first order system with first order measuring element. Determine the expression for the offset for servo mechanism control system. **07**

OR

Q.3 (a) What are static characteristic of an instrument? Define
1) Accuracy 2) Reproducibility 3) Sensitivity **07**

(b) Describe the principle, construction and working of thermocouple used for temperature measurement. **07**

Q.4 (a) A proportional controller having gain K_c is used to control two non-interacting liquid level tanks having time constant $\tau_1=1$ and $\tau_2=0.5$. For the unit feedback control system. Determine the stability of the system using Routh criterion. **07**

(b) Describe the construction and working of the optical pyrometer with neat figure. **07**

OR

Q.4 (a) 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.

(b) Describe the principle, construction and working of electromagnetic flow meter. What are its advantages and limitations? **07**

Q.5 (a) Define amplitude ratio and phase angle. Plot the Bode diagram for the first order control system. **07**

(b) What are the different types of the manometer? Explain in detail the enlarged lag manometer with the help of neat figure. **07**

OR

Q.5 (a) Derive the response equation for the under damped second order control system for step forcing function. **07**

(b) Describe the principle, construction and working of rotameter. **07**