53 (IE-605) PRIC

2015

PROCESS INSTRUMENTATION AND CONTROL

Paper : IE 605

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions out of seven.*

1. *(a)* Draw the basic instrumentation block diagram and discuss its functionalities. 7

(b) Define Transfer Function and derive the transfer function for n^{th} order linear time invariant system. 8

(c) A temperature sensitive transducer is subjected to sudden temperature change. It takes 10*sec* for the transducer to reach equilibrium condition (5 time constants). How long will it take for the transducer to read half the temperature difference ? 5

2. *(a)* A second order system has a mass of $8 \times 10^3 kg$ and stiffness of 1000 N/m. Calculate the natural frequency of the system. Determine the damping constant if the system is critically damped. Also calculate the frequency of damped oscillation if the damping ratio is reduced to 60% of its value. 8

(b) Draw the time domain specification of an under damped system and define the system terms. 6

(c) A platinum thermometer has a resistance of 100 *ohm* at 25°*C*. Find the resistance at 65°*C* if platinum has a resistance temperature co-efficient of 0·00385 *ohm*/°*C*. Also, if the thermometer has a resistance of 150 *ohm*, calculate the temperature. 6

3. *(a)* With neat sketch describe the working principle of differential Flowmeter and list the advantages and disadvantages. 10

(b) Discuss an arrangement to measure level of Fluid in a tank not under pressure with proper diagram. 10

4. *(a)* Discuss the working principle of vibrating tube densitometer and list the advantages and disadvantages. 10

(b) What is the principle of Viscosity Measurement? How viscosity can be measured using a capillary viscometer? 10

5. *(a)* Using Routh criterion, determine the stability of the system represented by the characteristic equation,

$$2S^5 + 2S^4 + 5S^3 + 5S^2 + 3S + 5 = 0 .$$

Comment on the location of the roots of characteristic equation? 10

(b) The characteristic equation of a certain Feedback Control System is

$$S^4 + 3S^3 + 3S^2 + S + K = 0 .$$

Determine the range of value of K_2 for which the system is stable. 10

6. *(a)* Find the transfer Function $H_3(S)/Q(S)$ for a three tank system in *Fig-01*, where H_3 and Q are deviation variables. 10

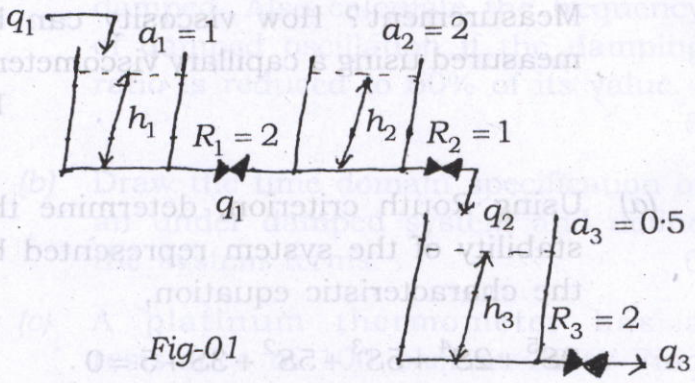

Fig-01

(b) For a unity Feedback Control System the open loop transfer function

$$G(S) = 10\,(S+2)/S^2\,(S+1)$$

Find

(i) The position, velocity and acceleration error constant,

(ii) The steady state error when the input is $R(S)$, where

$$R(S) = 3/S - 2/S^2 + 1/3S^3$$ 6

(c) How the system is classified depending on the value of damping ? 4

7. Find the overall gain $C(S)/R(S)$ for the signal Flow graph shown in *Fig-02.* 20

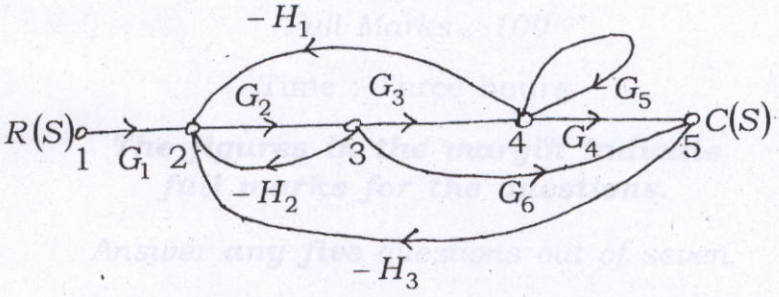

Fig-02